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# Occupational Health in Ontario

Volume 9, Number 2, Spring 1988

*The Effect of Combined Noise and Vibration Exposure on Hearing*

*Preventing and Dealing With Emergency Situations: A Guide to Helping in the Workplace*

*Unionization, Management/Labour Relations and Lost-Time Accidents*

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# Occupational Health in Ontario

## Volume 9, Number 2, Spring 1988

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3. U.S. Department of Health, Education and Welfare. Smoking and Health. A report of the U.S. Surgeon General, 1979.

**R. House, M.D., C.M., M.Sc., D.I.H., C.C.B.O.M.**

# The Effect of Combined Noise and Vibration Exposure on Hearing

**Summary**

*This article reviews the scientific and medical evidence suggesting that combined exposure to noise and vibration increases the risk of hearing loss compared to exposure to noise only.*

**Key Words: noise, vibration, hearing loss**

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Many workers are exposed to both noise and vibration (hand-arm or whole body). Indeed, the noise and vibration often originate from the same source, as, for example, would occur during the operation of a chain-saw.

The noise exposures that accompany hand-arm vibration are usually higher than those that accompany whole body vibration. For example, Tempest[1] gives the following representative noise level measurements (dB(A) Leq) for (a) various hand-arm vibration exposure jobs: riveting, 117; fettling (cast iron), 118; rock drilling, 120; chain-saw, up to 120; and (b) various whole body vibration jobs: four-wheel drive vehicle cab, 95; earth-mover cab, 97. Hence, given the high noise exposures that accompany vibration exposure jobs, especially hand-arm vibration, evidence of an added effect on the risk of noise-induced hearing loss due to the vibration could indicate an important occupational health problem.

In this article, I will review the scientific and medical evidence that suggests that combined exposure to noise and vibration (either hand-arm or whole body) increases the risk of hearing loss compared to exposure to noise only. There is seldom vibration exposure without concomitant noise exposure in industry. Therefore, it makes little practical sense to ask about the effect on hearing of vibration exposure only. Hence, this review is concerned with the question of whether concomitant exposure to vibration acts as an 'effect modifier' of the relation between noise exposure and hearing loss. An effect modifier is a factor that, although not a causal factor itself, modifies the effect of another causal factor.

## Possible Mechanisms for an Effect of Vibration on Hearing

Hyvarinen and Pyykko[2] have shown that various sensory stimuli, aside from vibration, can cause vasospasm, recorded by digital plethysmography in workers with vibration-induced white finger (VWF). They found that cooling and vibration of the hand were most effective in causing vasospasm, but the recorded noise of a chain-

saw (without vibration) or vibration in the opposite hand also reduced the pulse volume in the measured hand of some of these workers. These facts suggest that one mechanism leading to vasoconstriction in VWF is a sympathetic reflex integrated in the central nervous system. The results of some animal studies lend further credence to this hypothesis; for example, in anesthetized cats, vibration of a limb triggers a burst of activity in the abdominal sympathetic ganglia[3].

This stimulation of the sympathetic nervous system by local hand-arm vibration, and possibly whole body vibration, could result in more generalized vasoconstriction, including vasoconstriction of cochlear blood vessels. Anatomical evidence clearly points out the presence of adrenergic (sympathetic) axons in the arterioles of the inner ear[4]. It has been shown that electrical stimulation of the sympathetic cervical ganglia in animals leads to a decrease in cochlear blood flow (up to 25 per cent) as measured by the penetration of radioactive gelatinous particles in the cochlear vessels[5]. Such reduction in cochlear blood flow is a likely mechanism of noise-induced hearing loss[6].

Alternatively, the postulated effect of vibration on hearing loss might be related to direct transmission of vibration to the head and neck. However, there is considerable attenuation of vibrational energy as it travels through the body. For example, Rasmussen[7] describes an approximate attenuation of 40 dB from hand to head. Whole body vibration directed along the longitudinal axis of the body (Z-axis) produces the greatest transmissibility or whole body resonance at about 5 Hz. Below and above this frequency the vibration is gradually attenuated by the soft tissues of the body and resonance in the organs is similarly changed.

Another possible mechanism for the effect of hand-arm vibration exposure on hearing loss is suggested from various collagen vascular diseases such as polyarteritis nodosa and systemic lupus erythematosus. Patients with these diseases often have secondary Raynaud's Phenomenon and some also develop sensorineural hearing loss. Proposed mechanisms to explain this hearing loss include arteritis of the inner ear and microthrombi formation or microemboli causing ischemia in the inner ear vessels related to platelet hyperaggregability[8,9]. Increased platelet function has been found in patients with VWF[10] and might increase the probability of microthrombi formation or microemboli in cochlear vessels.

These suggested mechanisms, although speculative, indicate that there is biologic plausibility for an effect of vibration on hearing.

## Animal Studies

Hamernik, et al.[11] exposed 15 chinchillas – three groups each consisting of five animals – to either high impulse noise, whole body vibration or a combination of impulse noise and whole body vibration. The vibration consisted of one hour of sinusoidal 30 Hz vibration at 1 g rms acceleration; the noise consisted of 50 impulses at 155 dB intensity with a duration of 1.5 msec. at the rate of one/minute. Before exposure and at 1, 3, 5, 7, 24 hours, four days and one month after exposure, each animal's auditory evoked responses (AER) were measured at seven frequencies between 0.5 and 8 kHz by an electrode that had been implanted into the skull. The difference between pre- and post-exposure AER values allowed calculation of temporary threshold shift (TTS) and permanent threshold shift (PTS) for one month post-exposure. Chinchillas exposed to the vibration alone showed no significant TTS or PTS. The combination group at all test times and frequencies showed a greater TTS and PTS than did the groups exposed to noise or vibration alone. No P values were provided; apparently, no statistical tests of significances were performed. In addition, the cochleas of the combination group were more severely damaged (in terms of outer hair cell loss) than those in the groups exposed to noise or vibration only.

Hamernik, et al.[12] carried out a second similar study using 13 chinchillas to examine the effect on hearing of low-level impact noise and/or whole body vibration exposure. This time, the impact noise exposures were chosen to be more representative of human exposure conditions in industry, and consisted of a 113 dB peak noise level at a rate of one per sec. The vibration exposures were unchanged from the first study. The results again indicated that the combination exposure group had greater TTS and PTS and greater hair cell losses than the group exposed to only impact noise. Again, no P values were given for the comparison of any of the auditory outcomes in the three exposure groups.

Other animal studies have also suggested that vibration might have an affect on hearing. Jauhiainen, et al.[13], using the cochlear microphonic (CM) potential as an index of cochlear sensitivity to noise, showed an increase in the CM voltage in guinea-pigs after the animals were subjected to whole body vibration. Actually, as described by Temkin,[14] over 50 years have passed since Wittmack, Popow and Preobraschensky first presented evidence in a series of animal studies that vibration might affect hearing. In these studies, histologic findings revealed

some degeneration of the sensory structures of the cochlea after exposure to vibration alone or combinations of noise and vibration.

However, there is considerable variability between species in susceptibility to hearing loss from noise exposure and possibly from exposure to other agents such as vibration. Therefore, results from animal experiments cannot be extrapolated directly to humans.

## Noise Vibration Exposure Chamber Studies

A number of exposure chamber studies have been carried out to investigate the relation between hearing loss and exposure to noise and/or vibration. In most studies the vibration exposure has consisted of whole body rather than hand-arm vibration. The exposure chamber allows careful control of noise and vibration exposure. However, this is achieved at the expense of substituting TTS (instead of PTS) as the outcome of interest in these studies.

The first reported human exposure chamber study to investigate the relation between hearing loss and exposure to noise and/or vibration was carried out by Guignard and Coles in 1965.[15] No significant increase in TTS following exposure of eight men to noise and vibration, compared to exposure to noise or vibration alone, could be demonstrated. Similar exposure chamber studies with negative results were carried out by Sommer[16] and Pfander (a study published in German and described by Dupuis[17]).

However, the majority of these exposure chamber studies have found increased mean TTS after joint noise and vibration exposure, compared to exposure to either physical agent alone.

In 1970 Yamamura, et al.[18] reported the results of an exposure chamber study that demonstrated an increased mean TTS for subjects exposed to noise and whole body vibration compared to exposure to either physical agent. This was followed by a study by Okada, et al.,[19] which yielded similar results. Yokoyama, et al.[20] in addition to comparing TTS in eight young men after exposure to noise, whole body vibration, and noise plus vibration, also compared the recovery from TTS in these three exposure groups. The recovery of hearing after exposure was measured by recording serial TTS at 20 seconds and 3, 5, 7, 9, 11, 13, and 20 minutes following exposure. The results of this study once again indicated an increase in mean TTS after exposure to noise and vibration compared to exposure to noise alone; they also suggested a delay in recovery of TTS following noise and vibration exposure compared to noise exposure alone.

By far the most detailed exposure chamber studies of temporary hearing loss from noise/whole body vibration exposure have been carried out in Finland by Manninen. In the first study reported by Manninen[21] in 1983, 13 volunteers were each exposed on separate occasions to different frequency bandwidths of white noise of 90 dB(A) intensity. The different bandwidths were 2-4 kHz, 4-6 kHz, 6-8 kHz, 4-8 kHz, and 0.2-16 kHz. These noise exposures were then repeated for each subject with the additional exposure of whole body vibration (Z or vertical axis, 5 Hz sinusoidal vibration, 2.12 m/sec$^2$ rms acceleration). The audiometric results indicated that, for each of the 90 dB(A) noise bandwidth exposures, the average $TTS_2$ at 4 kHz audiometric frequency usually increased slightly during three successive 16-minute exposures, each followed immediately by a four-minute interval for audiometric measurements. For the noise with the widest bandwidth (0.2-16 kHz), the additional exposure of whole body vibration resulted in a statistically significant increase in the magnitude of $TTS_2$ after the third exposure period ($p<0.001$). The magnitude of this increase was about 30 per cent above that due to noise exposure alone. Similar findings were observed at the audiometric frequencies of 6 kHz and 8 kHz. Neither vibration exposure alone nor the test situation (no noise, no vibration) resulted in a $TTS_2$.

These results have been repeated in subsequent exposure chamber studies of similar design by Manninen[22] and Manninen and Ekblom.[23] In one of these studies, other exposure conditions, such as stochastic versus sinusoidal vibration during concomitant noise exposure, were investigated.[22] The added effect of vibration on $TTS_2$ values was particularly evident when the vibration was stochastic rather than sinusoidal. This finding is of interest because stochastic vibration is much more commonly encountered than sinusoidal vibration in the work environment.

Only two exposure chamber studies have investigated the relation between TTS and exposure to noise and/or hand-arm vibration. Dupuis[17] reviewed a study published in German by Weichenreider in 1977, in which individuals were exposed to various combinations of noise and segmental vibration for only eight minutes, followed by measurement of TTS. The noise level was kept constant at 100 dB(A) and the vibration frequency and intensity were varied with each eight-minute vibration exposure; the vibration exposure characteristics were chosen in four steps with frequencies between 16 and 1,000 Hz and acceleration between 4 and 250 m/sec$^2$. The results did

not indicate any significant effect on TTS due to vibration. However, as mentioned, the exposure duration for each noise/vibration combination was very short — only eight minutes. Kile and Wurzbach[24] compared TTS produced by exposure to noise, hand-arm vibration, and noise plus hand-arm vibration in young men with normal hearing. The noise source consisted of 65 dB(A) of white noise presented to the subject's right ear through an earphone mounted on a cushion and enclosed in an audiocup. The hand-arm vibration source consisted of an electric vibrator having a fundamental frequency of 10 Hz and an rms acceleration of 1,000 cm/sec$^2$. The 10 subjects received all three test exposure conditions (noise, vibration, noise plus vibration) in a sound-treated room, and each exposure lasted 45 minutes. Audiograms were obtained for each subject's right ear at 500 and 4,000 Hz audiometric frequencies immediately preceding and following each exposure session.

The results indicated that the mean TTS due to the joint exposure to noise and vibration was greater than the mean TTS due to just noise at both 500 and 4,000 Hz audiometric frequencies. Both of these results were statistically significant. At 4,000 Hz audiometric frequency, there was an 83 per cent increase in TTS due to joint exposure compared to exposure to just noise; the comparable increase in TTS at 500 Hz was 246 per cent. The exposure to just hand-arm vibration also produced a TTS in most subjects at both audiometric frequencies.

Also of interest in this study were the results of the subjects' impressions after each noise/vibration exposure. None expressed any discomfort or annoyance when exposed to noise of 65 dB(A). However, when vibration exposure was added, various changes in psychological and physiological states were reported. These included: (1) a high frequency tinnitus, (2) a sensation of fullness in the ears, (3) light-headedness, (4) 'euphoric states', (5) headaches, (6) soreness in the joints, and (7) physical fatigue. Most of the subjects were convinced that the vibration was causing vigorous auditory effects, and when later informed of their test results from vibration exposure conditions, they were often surprised that they did not have even greater shifts in hearing.

Also of note was the fact that the subjects were wearing an occlusive earphone to deliver the noise exposure. This earphone also probably magnified the effect of the hand-arm vibration transmitted to the ear by preventing its dissipation through the open ear. This might be comparable to workers wearing hearing protec-

tion in industry. Although the airborne sound transmitted to their ears would be attenuated by earmuffs or plugs, the vibration transmitted to the ear would likely be enhanced by this occlusive effect.

The advantage of these exposure chamber studies is that they allow careful control of the exposure of each subject to noise and/or vibration. In any observational or sub-experimental field study, one of the major potential confounders of a comparison of hearing loss in a group exposed to noise and vibration with a group exposed to just noise, is unequal noise exposure in the two groups. The noise exposure in exposure chamber studies is under the control of the experimenter, and, hence, audiometric results are not confounded by differences in noise exposure in the groups compared.

However, these exposure chamber studies have several drawbacks. The main ones include:

a) *The substitution of TTS for PTS.* The main outcome in exposure chamber studies is TTS from short-term noise/vibration exposure. However, TTS has poor predictive validity for the occurrence of subsequent PTS[25] and the use of TTS as the main outcome in exposure chamber studies may result in invalid conclusions about the relation between permanent hearing loss and exposure to noise and/or vibration. Definitive studies of hearing loss risk from specific exposures should be based on PTS rather than TTS.

b) *The order of exposure to noise and/or vibration.* In these exposure chamber studies, the subjects are usually exposed on separate occasions to noise, vibration, and combined noise and vibration. After each exposure, audiograms are done. Therefore, these studies most closely approximate the generic design of a crossover study. For this study design, subjects should be randomized to the order of presentation of the noise and/or vibration exposure to prevent an order effect from confounding the comparison of TTS in the three exposure groups. This is important because a learning effect has been demonstrated for subjects who are subjected to repeated audiograms; frequently, hearing appears to improve as individuals become more familiar with the audiometric technique. However, in most of the exposure chamber studies reviewed, the method of allocation to order of exposure to noise and/or vibration was not specified. In only one[22] was randomization definitely stated to have been carried out. In most instances, the subjects were given several

training audiograms so that they would become familiar with audiometric technique. This would tend to minimize the learning effect during the actual experiment. In all instances, an adequate time away from noise was allowed so that TTS from one exposure had disappeared prior to the subsequent exposure.

## Field Studies

### a) Descriptive Studies

In these descriptive studies there was no comparison of results in exposed and non-exposed groups.

Mathe[26] (1969) reported several cases of apparent noise-induced hearing loss among barbers. This finding was of interest because the noise levels produced by the barbers' automatic vibrating clippers are well below 85 dB(A). No other obvious cause of hearing loss was detected in these individuals. Hence, this case series suggested that combined vibration exposure plus fairly low noise levels could be a possible explanation for some of these case reports.

Further evidence to support this explanation was provided by a descriptive study of TTS in jewellers, reported by Taylor.[27] He found that among individuals using jewellers' engraving tools, some experienced TTS. Again, the noise exposure was well below 85 dB(A). Even with hearing protection, some of the exposed individuals still experienced TTS.

### b) Analytic Field Studies

In these analytic field studies, hearing loss was compared in workers exposed to noise and vibration and workers exposed to noise only.

Manninen[22] reviewed a study published in Russian by Pokrovskij of hearing loss of workers in the metals industry in Russia. Pokrovskij's results indicated that noise-induced hearing loss occurred twice as frequently in individuals working with vibrating machinery as in those not exposed to vibration. However, this difference in the prevalence of impaired hearing could not be interpreted solely as an adverse effect of vibration because the individuals working on the vibrating machinery were subjected during their workshift to an exposure of 30 minutes to noise exceeding the average noise level of the department by 5-7 dB(A). Pokrovskij also found that among those workers with hearing loss, the average duration of exposure before onset of reduced hearing was only 9.1 years for the workers exposed to noise plus vibration compared to 10.4 years for the group exposed to noise only.

Taniewski and Banaszkiewicz[28] reported that, in miners, occupational hearing loss was most common in those miners exposed to both noise and vibration – coal-face workers, loaders and workers in grading plants. The authors concluded that the development of hearing loss in miners is dependent to a great extent on hand-arm vibration, the effects of which, coal-face workers are particularly exposed to when drilling.

Pinter[29] compared the $TTS_2$ of tractor drivers exposed to noise and whole body vibration to that of workers in the furniture industry exposed to noise only. Both groups were exposed to equivalent noise levels of 90-98 dB(A). Greater temporary hearing loss was found in the tractor drivers exposed to both noise and vibration.

Rustam-Zade, et al.[30] evaluated the magnitude of PTS at various audiometric frequencies in female weavers exposed to noise of 96-101 dB(A). Greater losses of hearing were noted at audiometric frequencies of 125 and 250 Hz in weavers on the second to fourth floors, who were subjected simultaneously to noise and vibration exposure compared to workers on the first floor, who were exposed to noise only.

These field studies, which have compared hearing loss in workers exposed to noise and vibration and workers exposed to noise only, have all used cross-sectional designs. Usually, the determination of noise exposure was imprecise and the two groups compared may well have differed in noise exposure level and duration. Also, other potential confounders such as age and the use of hearing protection were usually not considered in the analysis.

Other epidemiologic studies have been carried out to investigate the relation between noise and vibration exposure and hearing loss. The studies mentioned previously compared hearing loss in workers exposed to noise and vibration and workers exposed to noise only. As well, there have been studies that compared hearing loss in workers with VWF and workers without VWF but exposed to comparable levels and duration of hand-arm vibration (and noise). These studies were therefore interested in the question of whether the presence of VWF indicates increased susceptibility to hearing loss in those workers exposed to noise and vibration. Pyykko, et al.[31] measured the hearing levels of a group of lumberjacks annually for six years and also recorded symptoms and signs of VWF. The number of subjects increased from 72 in the first year to 203 in the last year. The magnitude of PTS at 4 kHz audiometric frequency was compared in lumberjacks with and without VWF.

After control for noise exposure, permanent hearing loss was about 10 dB greater in lumberjacks with VWF than without VWF, and this difference was significant.

Subsequent case control studies by Pyykko and Starck,[32] Iki, et al.[33] and Pyykko, et al.[34] have also found increased hearing loss at particular audiometric frequencies for workers with VWF, compared to workers without VWF, after control for noise exposure and other factors.

However, these studies do not indicate whether workers exposed to noise and hand-arm vibration have increased risk of hearing loss compared to workers exposed to noise only. It may be that the presence of VWF is simply indicative of increased autonomic response to noise and therefore identifies a sub-group at increased risk of NIHL, but the entire group of workers exposed to noise and vibration might not have such increased risk compared to workers exposed to comparable levels of noise. A recent study by Pyykko, et al.[35] provides further support for this argument. In a group of 122 forest workers (exposed to noise and hand-arm vibration), they found, by using multiple linear regression, that the presence of VWF was significantly associated with the magnitude of hearing loss at 4,000 Hz. However, for the groups as a whole, there was no increased hearing loss compared to the predicted hearing loss from noise alone using the Burns-Robinson model.

Burns and Robinson[36] attempted to develop their model of hearing loss risk from a group of workers exposed mainly to continuous or steady state noise. However, workers who 'change position from time to time using noisy hand tools for fettling, chipping, burnishing or welding,' were included. Hence, some of the workers in their cohort were also exposed to both noise and vibration as were the forest workers selected by Pyykko, et al.

## Conclusion

The overall evidence from animal studies, human exposure chamber studies and observational studies in industry of the association between concurrent noise and vibration (whole body or hand-arm) exposure and increased hearing loss compared to exposure to just noise, is suggestive but not fully convincing of causality. Some of the Hill[37] criteria of causation, such as biological plausibility and consistency of published study results, might appear to be satisfied. However, in general, the basic study methods used have not been strong. In particular, as mentioned previously, in most of the observational studies in industry, noise measurement,

the measurement of other key potential confounders and the control for these factors to produce an unbiased comparison of hearing loss in workers exposed to noise plus vibration versus those exposed to noise only, have not been done effectively. In workers exposed to hand-arm vibration and noise, several studies have indicated that the presence of VWF is associated with increased sensorineural hearing loss; however, it is uncertain if the entire group (those with and without VWF) is at increased risk of hearing loss compared to workers exposed to noise only. Therefore, there is a need for additional well designed epidemiologic studies to clarify the relation between noise and vibration exposure and hearing loss.

**Résumé**

Cet article fait le point sur les données scientifiques et médicales selon lesquelles, comparée à l'exposition au bruit seulement, l'exposition conjointe au bruit et aux vibrations augmente le risque d'amoindrissement de l'acuité auditive.

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# Preventing and Dealing With Emergency Situations: A Guide to Helping in the Workplace

**Summary**

*This paper describes the helping process and the decisions that need to be made by individuals if they are to offer help in the form of safety advice, warnings and action during emergencies. While such help is often expected and may reduce injuries, it is not always forthcoming. Included are numerous recommendations to encourage helping behaviours within the workplace. These recommendations may be used by joint health and safety committees, safety professionals and associations, as well as employers, supervisors and employees to establish programs that help prevent and deal with emergency situations.*

**Key Words: helping, altruism, prevention, emergency, social, psychological, behavioural, bystander effect.**

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The benefits associated with helping (e.g. offering safety advice, warnings and help during emergencies) are multi-faceted and include reduced injuries and accidents, improved productivity and a positive influence on one's sense of well-being. The time and cost to implement the recommendations provided within this paper can be quickly offset by the elimination of inefficient and dangerous work practices. For example, a single offer of help in the form of a suggestion, warning or action during an emergency can prevent a costly and tragic accident and production stoppage.

The following is representative of what happens when people within the workplace fail to help. Occurrences such as these can be avoided by understanding and using the information about stimulating helping behaviours presented within the paper.

At a major Ontario company, three highly skilled employees were working together in a room. They were all trained in resuscitation techniques, but when one of the three suddenly suffered a fatal heart attack, the other two men did not offer help. Even though there was an emergency telephone located in the room, it took fifteen minutes before they decided to call for help. The employee was dead by the time help arrived. Later, when questioned regarding their hesitancy or failure to help, one person indicated a fear of liability, but neither of them could really explain their behaviour.

At another company in Ontario, an employee fell unconscious after inhaling toxic fumes. Two co-workers walked by this person and chose not to do anything about it. A third co-worker later rushed to the victim's aid, applied mouth-to-mouth resuscitation and saved the employee's life.

A survey at a large corporation revealed that employees who were employed less than three months failed to report 70 per cent of serious hazards and employees with a tenure of five years or more failed to report 30 per cent. Incidents and findings, like those just described, verify that, while help is often expected and may reduce injuries, it is not always forthcoming.

Most people can recall instances in their lives when they could have offered help but did not; and they still feel uneasy, even remorseful, about their lack of response. By understanding what influences our helping behaviour, we can make a more informed decision about how we wish to respond to a given situation.

A logical sequence of decisions is a prerequisite to helping; therefore, understanding these **decision steps** is fundamental to the development of programs to encourage helping behaviour.

The following four points are common to various theories on helping:

1. a hazard or event must be noticed;
2. the hazard or event must be interpreted as a potential danger or as an emergency situation requiring intervention by someone;
3. the bystander must decide to accept personal responsibility for helping, and;
4. the bystander must decide what specific action to take.

Many obscure factors, coupled with difficult circumstances, can contribute to confusion and lead to a failure to help. Certain characteristics of potential helping situations place considerable demands upon the interpretive and decision-making skills of the bystander. For example, emergency situations tend to be **exceptional, sudden, urgent** and **demanding**. Each of these characteristics may interfere with a bystander's ability to react appropriately.

Emergencies are **exceptional** in that they are rare and unusual events. What is happening and what to do about it may not be immediately obvious. They are also **sudden**, at least from the point of view of a bystander. Usually, a bystander's attention is drawn to an event that is already in progress. The precipitating causes may no longer be apparent; consequently, the bystander must guess at what is happening. For example, when noticing someone lying on the ground, one can't be sure that this person is there as a result of an accident, illness, or personal choice. Emergencies are **urgent** and **demanding** situations that require immediate response in often dangerous circumstances. Under some circumstances, bystanders must consider their own welfare as well as the welfare of the victim; however, there is often little time or no second chance for the bystander to intervene.

Emergency and non-emergency situations have some common characteristics that may influence the decisions that lead to helping or failure to help. One such

common characteristic is anxiety, which can interfere with making appropriate helping decisions. As anxiety increases, it limits one's ability to comprehend a situation in which helping behaviour may be required. For example, while battling a fire, a firefighter who happens to hear a cry for help will act in a seemingly heroic manner without noticing the ceiling about to collapse. Another firefighter may only notice the collapsing ceiling or falling debris, and not the cry for help. While this firefighter may appear to be a coward, the difference between him or her and the hero may only be what each happened to first notice. Later, when interviewed, heroes often readily admit they were unaware of the dangers or pain associated with their apparent bravery. Often, helping situations are not clear-cut, they can be ambiguous and seen from many perspectives.

## How to Stimulate Helping Behaviour

Prompts, hints or signals that assist with the process of making a helping decision come from our physical and social environment. Social prompts can be as obvious and simple as a request for help; however, not all social prompts are as direct. Physical prompts are things that we see, hear, smell or taste or that otherwise impact on our senses. As may be expected, helping responses increase as more physical prompts are available. Some factors, such as noise, clutter, etc., can interfere with a bystander's ability to react appropriately. For example, if the workplace is extremely noisy, it can encumber communication, act as a distraction and generally overshadow potentially hazardous situations. Distractions, such as noise or clutter, should be identified, minimized and/or compensated for by such means as hand signals and/or pre-work discussions.

People are less likely to help in an emergency when they are with others. This is called the **Bystander Effect** and the **Decision Steps**, presented earlier, help to explain why this occurs and how it can be overcome. These decision steps focus our attention on three factors that cause the Bystander Effect. First, what we notice is influenced by the presence of other people as they may cause distractions, divert attention, etc. Second, many bystanders tend to look to the reactions of others for an appropriate interpretation of events, which often results in common error. In our society people are trained not to over-react, to 'play it cool'. To avoid embarrassment, no one wants to be the first to appear upset or to act in a foolish or improper manner; therefore, one's expression of concern may be inhibited. By basing interpretations on the usually muted reaction of others, bystanders may

define the situation as less critical than they would if they were alone. Each bystander is less likely to take action until someone, somehow, clearly indicates that the situation is a serious one. Finally, the presence of others may influence a person's decision not to help because someone else can assume the responsibility for helping. When alone, one understands that if one does not help, there is no one else to assume responsibility. When others are present, there is a diffusion of responsibility for helping.

To overcome the problems associated with the bystander effect: inform employees about the bystander effect and what contributes to it; encourage employees to look for potential hazards, emphasizing that their concerns have merit and should be investigated and/or resolved in a suitable manner (e.g. signs should be posted in designated hazardous areas for all to be 'on guard' about other's safety); ensure social and physical signals and/or prompts are readily available and identifiable (e.g. emergency flags or hand signals that can be deployed quickly as soon as a problem is noticed); and, work with employees to establish a policy that co-ordinates not only names of individuals to contact in an emergency or non-emergency situation, but also a detailed description of procedures to follow, location and operation of emergency or safety equipment, etc.

## Making Helping Behaviour Pay

By lowering the costs and increasing the benefits associated with helping, help is more likely to be offered. The following identifies some of these costs and benefits and recommends how to deal with them.

### Lowering Costs

The first step in lowering the costs associated with helping is identifying them. Not all costs are immediately obvious; they may be financial, social, physical, etc. Each cost can produce anxiety and, therefore, may result in various forms of avoidance, such as not acknowledging a problem or not accepting personal responsibility for helping.

The bystander is less inclined to offer help when the consequences of helping appear to be unpleasant or dangerous. This means that, where possible, safety procedures or equipment should be implemented to compensate for any unpleasant or harmful exposures to the helper. As well, detailed information about hazards and the extent of dangers should be provided to avoid unwarranted fears that may interfere with helping.

When it is an employee's responsibility to meet deadlines, especially when time is at a premium, he or she is less likely to help another person. For example, when a number of individuals were late for their own presentations on 'The Good Samaritan', they failed to heed the message they were about to present. They ignored the coughing and groaning of a man slumped in a doorway, and some, literally, stepped over him so that they would not face the embarrassment of being late. To avoid this problem, initiate means to demonstrate to employees that even while working to meet deadlines, time taken to provide help is appreciated, e.g. one will not be penalized for helpfulness. Also, encourage employees working under time constraints to maintain high safety standards and watch for emergency or other potential helping situations.

Possible embarrassment or the social cost of appearing foolish and/or inept may deter helping behaviour. The less familiar one is with a particular job or work environment, the greater the chance that offering help will lead to embarrassing consequences and, perhaps, some loss of social status. A new employee may wish to offer help, but may not know what to do or where appropriate equipment or services are located. To overcome this problem, there should be means to instil confidence in employees so that they may express their health and safety concerns to appropriate personnel, e.g. orientation for all employees. As well, employees should have the opportunity to communicate their concerns with a minimum of embarrassment (e.g. suggestion box).

At times, offers of help may be interpreted as criticism. Because of this, a person may not offer help in order to avoid being subjected to embarrassment, humiliation, violence or threats of violence. This is especially true if the person to whom help is being offered has a history of responding to such acts with aggression. To deal with this, encourage employees to accept co-workers' advice as an act of helpfulness rather than as an insult or a threat; provide a resource to resolve issues if employees interpret helpfulness as an interference or an annoyance; and/or develop diplomatic, non-threatening, even humorous, means of providing safety advice and warnings (e.g. humorous cards that can be passed anonymously).

People may reconsider offering their help if it leads to a greater commitment than they are prepared to accept. Therefore, all employees should be informed of health and safety resources to which they may refer their

co-workers. Also, once a problem has been brought to the supervisor's attention, it is his/her responsibility to ensure that help is provided.

At times, people have a tendency to feel that their concerns are relatively insignificant, and so they ignore them. However, all concerns should be voiced to appropriate personnel. To ensure this, reinforce that even seemingly trivial concerns are legitimate, can have major impact and should be voiced.

**Increasing Rewards**

Financial or material rewards can stimulate helping, but not always. The promise of a reward may, in fact, detract from the act of helping. For example, a worker may enjoy teaching an employee how to do a new job; however, if the reward for helping is contingent upon the new employee attaining a certain level of performance, any slow progress may cause frustration, irritation and a strain in their relationship. In other words, provide social, financial and/or material rewards for offering help, and ensure that employees are aware of these rewards. However, rewards for helping should not be so significant that they interfere with the intrinsic rewards of helping behaviours.

People are more willing to offer help when they know others appreciate their efforts. The approval of a superior or respected co-worker can be of particular value in stimulating helping behaviours. Immediate supervisors and co-workers should show appreciation for, and apprise management of, helpful acts so that it too can express its gratitude.

Workers will offer help when it is made obvious that helpfulness is expected by all and is a means by which respect is gained. Employees should have an opportunity to discuss why helping did not occur and what can be done to prevent this in the future.

Less popular employees do not receive as much informal safety advice and warnings as do popular employees. All important health and safety information should be *formally* communicated to all employees by management. However, because of familiarity, co-workers may take each other for granted and assume they may not need help. To avoid this, remind employees that old friends and experienced colleagues can still benefit from safety advice and warnings.

Helping will be stimulated by a spirit of teamwork when employees are provided with common goals to work towards and when they are given an opportunity to communicate and discover their commonalities. Offering

help, particularly when it prevents an accident or injury, can maintain good morale as well as the health and safety of all concerned. Friendship and a sense of camaraderie should be encouraged within the workplace. Also, remind workers that accidents cause not only physical, but social and financial, distress.

Often, employees do not achieve a sense of meaning from their jobs or they feel alienated from them, i.e. they feel like a small cog in a large machine. Helping others at work can add meaning to one's job. Employees should be encouraged to take an interest in their co-workers' well-being as a way of achieving a greater sense of personal effectiveness and involvement.

Seeing the impact of one's helpful acts motivates future acts of helping. Managers who fail to respond to employees' safety concerns will discourage them from voicing their concerns in the future. Employees who fail to appreciate safety advice or warnings will eventually discourage the helpfulness of others. Management should act quickly when a safety concern is brought to its attention. If action is not taken, employees should be informed why as soon as possible. Employees should also be encouraged to express appreciation for safety advice and, if they do not agree, to discuss the situation until mutually resolved.

**Mobilizing Morals, Moods and Feelings**

Two widely-held social beliefs are: (1) people should help those who depend upon them and need their assistance, and (2) people should help those who have helped them. If a person's problems are ignored, he/she will be indifferent to the problems of others.

Helpfulness can come into conflict with other social beliefs; one such belief being a respect for privacy. Since interference may be construed as a violation of privacy, employees may avoid offering help and may avert their attention from the dangers or problems a co-worker may face. However, workers should be reminded to balance their respect for others' privacy with respect for their well-being.

Employees with high self-respect are more likely to offer help. Humanistic management practices, charity efforts and other programs can be instituted to encourage employee self-respect.

Knowledgeable and confident employees are more likely to take the initiative to express safety concerns and/or warnings or provide emergency assistance. Accordingly, provide courses in the skills necessary to provide help, such as first aid training and/or programs to encourage assertiveness and confidence.

To preserve the established chain of command, supervisors may sometimes withhold safety advice or warnings from employees not directly under their authority. As a result of this, employees feel that health and safety advice is the prerogative of management and that, therefore, they should not disrupt their own or others' work to offer help. Clear policies should be established for employees who, on occasion, find it necessary to disrupt the usual lines of authority in a health and safety matter.

The more people are perceived as being responsible for their own plight, the less inclined others are to provide assistance. Thus, employees who work in a reckless manner, such as under the influence of alcohol, may not be given the necessary advice, warnings or help. Therefore, it is of value to identify to employees and management what each is to do in situations where co-workers' inappropriate behaviour may have harmful consequences.

Offers of help should not be made unless there is every intention of keeping them. When help is promised and the promise is not fulfilled, the result is usually resentment. In other words, keep commitments regarding offers of help.

The more helping obligates, the more likely it is to cause irritation and ingratitude. When someone helps another person and continually reminds him or her of it, it can lead to resentment and an unwillingness to return the favour. Avoid making demands on other people as a consequence of your providing help.

In general, it appears that people who are happy are more likely to help; people who are in a negative mood can be distracted from helping. A positive atmosphere in the workplace can generate helping behaviours.

A sense of responsibility towards a co-worker will encourage helping behaviour. It would be of value to identify to employees their unique responsibilities for each other's health and safety.

People often need to maintain their belief in a fair and just world. As a result, they may justify not helping those they see as deserving of punishment and ignore the seriousness of a popular employee's unsafe practices because bad things are not supposed to happen to good people. Employees should be made aware of how the desire to see the world as a just place may influence their helping behaviour.

**Requests for Help**

Often, the most effective way to stimulate helping is to request help. The recommendations provided to stimu-

late helping behaviour may be adapted to stimulate requests for help. There are two reasons for this. First, prior to requesting help, a person may take into account the costs and benefits to him- or herself and the potential helper as well as the morals, moods and feeling of both. Second, the decision to request help is directly influenced by many of the same factors that influence helping behaviour. For example, two factors that influence both helping and requests for help are the number of bystanders present, and training. Requesting help, like offering help, decreases as the number of bystanders increase. This may occur because such requests may involve several social costs like appearing incompetent, dependent or otherwise weak. With more persons present, the social costs of requests would increase. Requesting help often requires some skill in diplomacy and asserting one's self. Like offering help, requesting it can be inhibited by a lack of confidence or competence in one's skill to do so. When implementing each of the recommendations for stimulating offers of help, consideration should be given to how to stimulate requests for help.

## Conclusion

This paper offers a series of recommendations that may be selected and combined into programs to stimulate helping behaviour within the workplace. These recommendations can be adapted to the needs and characteristics of specific workplaces. The impact of such a program will depend upon the degree to which the recommendations offered appear relevant to employees and management. Before selecting and adapting these recommendations, an assessment of the needs and interests present within the workplace, perhaps by means of a survey, should be done. This information can then be used to ensure the acceptability and effectiveness of the program.

Many of the recommendations may be viewed as basic humanistic management practices and some may be dismissed as mere common sense. However, what may be dismissed as common sense is often not acted upon or formulated into a policy or program. Take the time to check out that such 'common sense' ideas are really used within the workplace and are supported by policies and programs.


## Résumé

Cet article décrit le processus du secourisme et les décisions que les personnes doivent prendre si elles veulent offrir de l'aide dans les situations d'urgence que ce soit sous forme de conseils, d'avertissements ou

d'actes de secourisme. Cette aide sur laquelle on compte souvent peut contribuer à réduire la gravité des blessures, mais elle n'est pas nécessairement toujours offerte. L'article comprend de nombreuses recommandations visant à encourager les gens à intervenir pour aider les autres en milieu de travail. Ces recommandations peuvent être utilisées par les comités mixtes de santé et de sécurité, les professionnels et les associations qui oeuvrent dans le domaine de la sécurité, les employeurs, les superviseurs et les employés pour établir des programmes visant à prévenir les cas d'urgence et à y faire face, le cas échéant.

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**Peter T. Suschnigg, Ph.D.**

# Unionization, Management/ Labour Relations and Lost-Time Accidents*

**Summary**

*This paper presents the preliminary findings of a study investigating the effect of management labour relations and labour organization on the 1985 lost-time accident record of three large, integrated steel mills in Ontario. Two incommensurate theoretical perspectives, the Family and the Adversarial models, and three modes of management labour relations, each characteristic of one of the three companies, are posited. Contending hypotheses, drawn from each perspective on management labour relations, are tested in an ANOVA model. Although further work needs to be done, the findings support one hypothesis based on the Adversarial model but fail to confirm a contending hypothesis drawn from the Family model.*

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This paper reports ongoing research into the effects of management/labour relations on lost-time accident rates in three Ontario steel mills during 1985. The processes involved in the management/labour relationship and their impact on work-related accidents are, as yet, only poorly understood, partly because of current explanations that reflect prevailing world views. It is widely agreed, however, that the degree and type of labour organization at the workplace is one of the major determinants that shapes the relationship between management and labour. In addition, labour organization itself may affect workplace health and safety. The currently favoured explanation holds that unionization, among blue-collar workers, at least[1] is associated with higher injury frequency rates.† In contrast, a minority of researchers argues that strong labour organization is more likely to be linked to lower injury frequency rates. Two examples will serve to illustrate this debate.

Appleton and Baker[2] summarizing their research into 213 Kentucky and Virginia coal mines, concluded that unionization had a detrimental effect on safety in bituminous deep mines. Inspection of their published results suggests that unionization alone accounted for an additional six work-related injuries per 200,000 person-hours worked. Considering only disabling injuries, they found injury rates in unionized mines to be five per 200,000 person-hours higher than those of non-unionized mines.

Appleton and Baker attribute the higher injury rates in unionized mines to the United Mine Workers' Union's restrictive job-bidding and labour allocation practices.

*An earlier version of this paper was presented at the 22nd Annual Meeting of the Canadian Anthropology and Sociology Association, McMaster University, Hamilton, Ontario, June 2, 1987.

†This paper limits itself to a consideration of lost-time injury rates since the current methods of computing accident severity rates are potentially misleading. Some companies calculate this statistic – which expresses the ratio of days lost through lost-time accidents and the number of hours worked – from the beginning of each calendar year. This approach reduces the level of accident severity rates at the beginning of each year and makes comparison with other companies' data very difficult.

They argue that workers in the more flexible, non-unionized mines, unlike their brethren in unionized mines, can be trained for a greater variety of jobs. Partly because of this strategy, workers in non-unionized mines rarely find themselves in a job with which they are not familiar. Unionized workers, on the other hand, when required to fill in for absent workers, may be placed into jobs beyond their experience. Accepting earlier reports[3] of increased levels of drug and alcohol abuse among unionized workers and 'allegations of faked injuries in union mines',[4] Appleton and Baker suggest that unionized workers are possibly less motivated than their non-unionized counterparts. The authors also feel that lack of motivation makes these workers 'less efficient coal producers . . . (and) less effective in the difficult task of providing mine safety'.[5]

Appleton and Baker's research has been criticized on substantive[6] as well as on statistical grounds.[7] Suffice to say that these researchers explain the discrepancy in mine safety by going well beyond the data in their model. Their argument is, nevertheless, a fair example of a school of thought that ascribes work-related accidents to a human penchant for slovenliness aggravated by union intransigence.

Grunberg,[8] representing the other side of the debate, investigated the relationship between safety, productivity and the social relations of production. Drawing on the Marxist tradition, he argues that the drive to increase productivity leads to an intensification of labour, which, in turn, leads to increased accident rates.

Since the intensity of labour is a consequence of the relations of production, Grunberg asserts that 'the more relations of production favour management, the greater will be the intensity of labour'.[9] It follows then, that work-related accidents will vary with the ability of workers to circumscribe the power of management. Stated another way, the more strongly workers are organized on the shop floor, the lower accident rates should be.

To test his hypotheses, Grunberg investigated two Chrysler plants, one in the U.K. (Ryton), the other in France (Poissy). Although both plants were unionized, Grunberg found considerable disparity in the intensity of labour:

> Very simply, Ryton workers spent less time working than Poissy workers, and the work they did was at a slower pace. Moreover, they had a far greater ability to influence the conditions of their work than did the Poissy workers.[10]

An analysis of the dispute records in both plants revealed another difference. Workers at the U.K. plant frequently complained about conditions of work and expressed concerns over safety. The workers at Chrysler France, on the other hand, were acquiescent.

Grunberg reports accident severity,* rather than frequency† in his comparison of accident rates for the two plants. He found a severity rate of 4.5 for Chrysler U.K., 72 for the whole Chrysler Corporation (16 times higher), and 292 for the French plant (over 60 times higher).[11]

Grunberg draws three major conclusions: First, he states that the lower the intensity of labour, the lower the accident rate will be. He further asserts that workers rather than management tend to be the best guarantors of worker safety. His final conclusion relates to the 'inherent law of capitalist production';[12] since companies need to make a profit in order to stay in business, those companies whose workers are more successful in imposing greater safety and lower intensity of labour are likely to lose their competitive position.

Re-examining the arguments so far: On one side are those who claim that a Family model best reflects the common interests of management and labour. The proponents of this approach say that workers' and employers' interests are ultimately in harmony. Occasional tension and conflict between workers and their employers is to be expected, just as it is within families. The solution, it is argued, is better communication within and between worker and management groups. Given the rather paternalistic family ideology permeating Canadian society, this model also implies that, in the last instance, father (or management) knows best.

The Family model has a certain seductiveness and lies at the root of labour legislation concerned with workers' health and safety.‡ It is a theoretical model that permits a wide variety of management styles and gives meaning to labour/management relations. From within its framework management may perceive workers' organization

* Grunberg defines the severity rate as expressing the number of working days lost due to work-related injuries per 200,000 person-hours worked.

† Frequency rates express the number of injuries per 1,000,000 or 200,000 hours worked. Although most jurisdictions use the 1,000,000-hour standard, there are others that prefer the 200,000-hour standard as it more closely parallels the frequency per 100 person-years worked.

‡ In Canada the 'family' philosophy finds its most influential expression in the Ham Report,[12] providing the impetus for the *Occupational Health and Safety Act, 1978*.[13] The Ministry of Labour states that 'The Act is based on the principle that hazards can best be dealt with in the workplace itself through **communication and co-operation** (author's emphasis) between employers and workers'.[14]

as a partner contributing to the greater good of the enterprise as a type of loyal opposition, or as a subversive activity.

Work-related accidents, according to the Family model, are best prevented by management/labour co-operation.* However, in the case of substantial disagreement between management and labour, management would have to have the last word. It follows that those workplaces with the lowest levels of management/labour conflict should have the lowest work-related injury rates. I shall call this low conflict mode of management/labour relations, Compliance, reflecting the attitude and behaviour of workers in the relationship.

In contrast to the Family model, the Adversarial model, as exemplified in Grunberg's argument, rejects the notion that the interests of labour and management are identical. Proponents of the Adversarial model argue that workers, rather than their employers, are the better guardians of health and safety at work. Thus labour's ability to exercise control over labour processes and the work environment, particularly over workplace safety, should reduce accident rates, even though this may lead to high levels of management/labour conflict. I refer to this high conflict mode of management/labour relations as Resistance, again reflecting the attitude and behaviour of workers in the relationship.

Periods of economic downturn and stagnation, inasmuch as they erode the ability of labour to resist management dictates, may mold the Resistance mode of management/labour relations into one of Accommodation.[16]

The two major theoretical approaches, the Family model and the Adversarial model, and the three modes of management/labour relations, Compliance, Resistance, and Accommodation, will provide the conceptual framework for analysing the question central to this study: Are industrial accident rates affected by management/labour relations?†

For each theoretical model a set of hypotheses for each mode of management/labour relations can be constructed and tested.

* This notion, although not written into the present *Occupational Health and Safety Act,* has become known as the Internal Responsibility System (IRS).[15]

†It is important to point out that management/labour relations are themselves embedded in the wider economic, social and political system. Although external conditions shape management/labour relations in various ways, a thorough discussion of the effects of these wider influences is beyond the scope of this study.

**Hypotheses**

The Family model predicts that:

a) Injury frequency rates will be lowest under Compliance.

Both management and labour are thought to be committed to the same goals, one of which is a healthy and safe workplace.

b) Injury frequency rates will be highest under Resistance.

High rates are predicted as workers would resist management directives of all kinds, among them, attempts to provide a healthy and safe workplace. In addition, workers would be faking injuries.

c) Injury frequency rates under Accommodation will be somewhat lower than under Resistance.

Injury frequency rates would presumably drop depending on the degree to which workers stop resisting management and faking injuries.

The Adversarial model, however, predicts that:

a) Injury frequency rates will be lowest under Resistance.

Workers who are able to resist management decrees that would threaten their health and safety and who know how to protect themselves from arbitrary management sanctions are less likely to endanger themselves.

b) Injury frequency rates will be highest under Compliance.

This would be because workers are least aware of their own safety interests and would not resist management decrees even if these decrees were against workers' interests. Compliant behaviour patterns would be reinforced by fellow workers.

c) Injury frequency rates under Accommodation will be somewhere between these extremes, depending on the degree of accommodation.

Table 1 describes the expected outcomes under each model:

**Table 1** **Predicted Injury Frequency Rates**

| Model | Modes of Management/Labour Relations | | |
|---|---|---|---|
| | Organized | | Not Organized |
| | Resistance | Accommodation | Compliance |
| Family | High | Moderate | Low |
| Adversarial | Low | Moderate/High | High |

Given identical conditions,* hypothesized injury and severity rates under the Family and Adversarial models are incompatible. This contradiction provides an opportunity to subject two competing hypotheses to a critical test.†

## Management/Labour Relations

The three posited modes of management/labour relations appear to be well reflected by Ontario's three largest producers of steel. Management/labour relations in 1985 were characterized by Accommodation at Company A, by Resistance at Company B's major plant and by Compliance at Company C's works.

In 1985 these three plants produced about 10,706,000 tonnes,‡or approximately 60 per cent of all the raw steel in Canada.[17] Although the product mix was somewhat different at each plant, all of them produced basic steel products, such as hot and cold rolled sheet, using very

* The problem of achieving the ideal of identical conditions is, of course, unattainable in the real world. The best non-experimental social scientists can hope for are good matches and a thorough understanding of processes so that the most important variables can be controlled.

†I have been fortunate to obtain the lost-time accident records, for 1985, for Ontario's three largest steel producers. Since my work has been focused on Company B and I have had the assistance of the union local there, my knowledge of the other two companies, by comparison, is somewhat superficial.

‡Although this is reported in metric tonnes, company reports are still based on imperial measurements.

similar technologies.* The companies were also committed to the implementation of such new technologies as continuous casting, ladle metallurgy, and statistical control processes to equip their respective plants with the best new technologies.[19] Differences in productivity levels are therefore likely to reflect labour intensity and market conditions rather than differences in technology.

Company B's and C's plants are located next to each other and draw from the same pool of labour, although the respective companies' labour relations policies may have encouraged a degree of self-selection among its work force. External factors such as the level of employment in the local population, however, are identical.

Company A is the largest employer in its region and differs somewhat from the other two in that steel pipe is included in its product line. Company A's product mix and its dependence on the petrochemical industry precipitated a sharp decline in its profitability that began in 1981, causing it to be labelled 'the sick man of Canada's steel industry'.[20] These problems showed no sign of abating during 1985.

## 1. *Accommodation* in Company A

Company A is Ontario's third largest producer of steel. In 1985 it produced 2,742,000 tons of raw steel. The falling demand for steel has hit this firm harder than the other two producers because, as mentioned, a significant part of its product line is dependent on the health of the petrochemical industry. The company has failed to turn in a profit since 1981, although the magnitude of losses had declined from their peak in 1983; by 1985 more than half of its work force had been laid off. The 1981 recession, while worrisome for shareholders, has weakened labour and forced the management/labour relationship into one of Accommodation. Indeed, as shown in Table 2, the intensity of labour, as measured by the number of hours worked plant-wide to produce a ton of steel, was highest in this company.

More layoffs were likely, and the company asked the union for concessions under the threat of cutbacks and the closure of some operations. Before agreeing to concessions, the union asked to see the company's

* Following Woodward,[18] the technological level of these plants can be placed between Category IX (process production in batches) and Category X (continuous flow production of liquid gases and solid shapes).

books. Given the company's poor economic state, it was likely that the union would have to give way.*

It is interesting, against this background, to read McKenzie and Laskin's glowing assessment of the company's health and safety program in their recent report:

> [Company A] has one of the most comprehensive and operational occupational health and safety programs in the province. Relations between the union and management are co-operative and recognized to be mutually beneficial.[21]

McKenzie and Laskin ascribe that harmonious state to a desire on the part of management and labour to 'explore new approaches to health and safety' following four work related fatalities in 1980. Whatever the reasons, management/labour relations at Company A are now characterized by Accommodation.

**Table 2** **Working Hours, Plantwide, to Produce One Ton of Raw Steel**

| Company | Steel (000s tons) | Hours/Ton (approx.) |
|---|---|---|
| A (Accommodation) | 2,742 | 4 hrs 50 m |
| B (Resistance) | 3,591 | 5 hrs 56 m |
| C (Compliance) | 4,373 | 5 hrs 2 m |

SOURCES: For steel produced: The Financial Post Information Service. CUSIP Number 015662, May 14, 1987 (Company A) CUSIP Number 858525, June 11, 1987 (Company B) The figure for steel produced by the plant used in this study was derived by subtracting 1,400,00 tons produced by the company's second works from the reported annual total. CUSIP Number 256900, July 31, 1987 (Company C). For working hours: Company accident severity reports.

* This assessment was shown to be premature. In 1987, workers at three locations accepted a one-year contract that froze wages but improved pension benefits. Given company demands for rollbacks, the contract was a major success for the union.

## 2. *Resistance* in Company B

Management/labour relations at Company B's works fit the posited mode of Resistance well. In 1946 a long history of contest between labour and management culminated in a bitter strike a little more than two years after the current local of the United Steelworkers of America had been recognized as the bargaining agent for the company's hourly employees.*

Bill Freeman[22] distinguishes three phases in the history of industrial relations at Company B. Between 1910 – the year of the company's foundation – and 1935, organized labour was more or less ignored by management. A strike by sheet mill workers in 1935 provoked an actively anti-union company policy that lasted until a strike in 1946. Since then, the adversarial relationship between management and labour has become formally institutionalized, and both sides have reached a *modus vivendi* within the general framework dictated by labour law.

By 1985, the year for which I have been gathering information and data, the local had already lost several thousand of its members to the recession of 1981 and was engaged in ongoing negotiations with the company to come to terms with the effects of technological change. Despite the threat of unemployment to many of its members, the local's numerous committees and workers† on the shop floor were reasonably successful in resisting company attempts to increase the intensity of labour. Table 2 shows that it took almost six working hours plant-wide to produce one ton of steel. A grievance committee deals with about one hundred grievances each month. Of these, approximately 20 are eventually referred to outside arbitrators because the union and the company are unable to agree on a solution.

A health and safety committee appoints and trains about 350 health and safety representatives in the plant and arranges short courses for all employees. However, an occupational health and safety clinic set up by the union local in 1984 fell victim to internal disputes and lapsed in October 1985. Thus it is important to remem-

* The history of that relationship is one of the major themes in Bill Freeman's (1982) *1005: Political Life in a Union Local*.[19]

†Company attempts to impose tighter control over scarfers, for instance, met with immediate and collective resistance by the workers. The shop steward, although clearly supportive of the scarfers' grievance, did not initiate the conflict.

ber that the local is not a monolithic organization, always united on the best course of action for its members in its relations with the company.

There is no question that the overall management/labour relationship in Company B closely fits our notion of Resistance.

### 3. *Compliance* in Company C

Company C is second in output but first in profitability among Ontario's steel producers. Its motto 'Our Product Is Steel, Our Strength Is People' is meant to encapsulate the company's policy towards its workers. It is a policy that seems to be successful because its work force is not unionized, despite its proximity to Company B's unionized work force. Labour intensity, as shown in Table 2, was higher than at Company B's plant and only slightly below that of Company A.

The extent of the company's sway over its workers is demonstrated in its health and safety program. Company A is one of only four among the more than 200,000 workplaces in Ontario that have a ministerial exemption allowing them to substitute their own health and safety programs in place of the joint health and safety committee prescribed by the *Occupational Health and Safety Act.* In 1979 the company applied to the Minister of Labour for an exemption under section 8(2) of the Act and was asked to provide evidence that the workers supported the continuation of the existing company program. The company replied that it had surveyed approximately 8,000 of its workers and that 96 per cent of those questioned felt that the company program had been successful in resolving any health and safety concerns they had had in the past; 98 per cent of the workers surveyed supported the company's request for approval of their health and safety program.

Following submissions made by Local 1005 in a brief to last year's NDP Task Force on Occupational Health and Safety, questions about Company A's exemption were raised in the Provincial Legislature by Elie Martel, MPP, and the present Minister of Labour is now reconsidering the four exemptions.

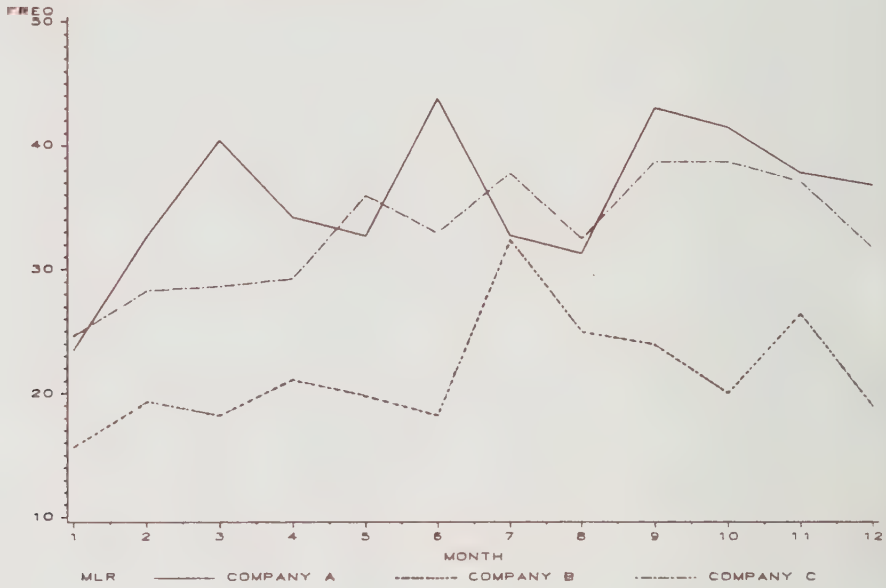
## A Model to Estimate the Differences in Injury Rates

The central question to be answered is whether the differences between the companies' injury rates, as they are displayed in the Figure below, are statistically significant, and whether these differences can be attributed to differences in management/labour relations and other economic and social factors. Since this research is still

ongoing, many factors that might contribute to a more detailed comparison are still being tabulated.*

**Figure 1**

**Lost-Time Accident Frequency Rates for Three Steel Producers in Ontario, 1985**




Sources: A: Monthly Aggregate Accident Reports, 1985
B: Company Accident Reports, WCB data, 1985
C: Monthly Aggregate Accident Reports, 1985

Factors thought to affect injury rates are classified as follows:

1. **Internal environment,** such as the quality of the relationship between management and labour, as well as the level of technology (i.e. machinery, equipment and processes).

2. **External environment.** Primarily social, economic and political conditions, such as the level of economic activity and employment in the region, as well as political sentiment regarding business activity.

3. **Temporal changes,** such as seasonal or monthly differences.

4. **Random,** such as breakdowns in production due to chance failure in machinery and equipment and other unmeasurable factors.

* In addition, an effort is being made to develop a better instrument to measure modes of management/labour relations in order to replace the rather crude one being used in this report.

Table 3 specifies the variables used to estimate the differences in injury rates between the three modes of management/labour relations. The data are for the year 1985 and are based on monthly summary reports of lost-time accidents by Companies A and C. Data for Company A's Tube Division (different technology) and those pertaining to the office personnel (different management/labour relations as compared to blue-collar workers) of all three companies were omitted from the analysis to make the databases as compatible as possible. The data for Company B are summaries of individual lost-time accident reports submitted by the company to the Ontario Workers' Compensation Board.*

The choice of lost-time accidents, rather than all types of accidents and injuries, is merely a pragmatic response to the uncertainties connected with accident reporting. Since the implementation of the *Occupational Health and Safety Act* in 1979, we can be confident that the more serious injuries are fairly reliably reported. Injury severity rates, on the other hand, are difficult to interpret. It is possible to argue that workers at a strongly unionized plant are more likely to take longer to return to work after an injury as their

**Table 3** **Variables Used**

1. Internal environment:

   **Management/Labour Relations**

   i. Accommodation
   ii. Compliance
   iii. Resistance

2. External environment:

   **Employment/Population Ratio**

   As measured and defined by Statistics Canada. (*The Labour Force,* Labour Force Economic Regions, monthly, Table 54, Cat. 72-002)

3. Temporal changes:

   **Month**

*These data, after tabulation from individual accident report forms, were checked for consistency against the database compiled by the board.

union will discourage the return to work of a 'walking wounded'. Management at Company C, however, suggests that its workers are encouraged by the company to recuperate completely before returning to work. In short, the significance of accident severity rates is open to some dispute. Less serious injuries and 'near misses' – accidents with potentially very serious outcomes – are almost *terra incognita* to social scientists.

Only a very small number of variables that are thought to affect accident rates have been used in this analysis. A chief reason is that detailed data are not available for Companies A and C. Company C, for example, refuses requests for data from independent researchers 'as a matter of policy'.* This stance prevents the inclusion of control variables such as workers' experience, age, the type of accident and injury, and the outcome of grievance resolution procedures.† Another reason is that data collection is continuing; an effort is being made, for instance, to obtain some measure of intensity of labour from companies. Monthly production figures and departmental manning might serve as indicators of labour intensity, but, while monthly data for the Canadian steel industry as a whole are published and each company reports its yearly production figures, companies' monthly production figures and departmental manning levels are restricted information.

According to both the Family and Adversarial models, accident rates are expected to vary with the mode of management/labour relations. But while the Family model predicts high accident rates under a Resistance mode of relations and low accident rates under a Compliance mode of relations, the Adversarial model predicts the opposite.

Inspection of Figure 1 reveals that, in 1985, at least, the data appear to support one of the hypotheses derived from the Adversarial model, that is, that accident rates will be low under Resistance and high under

* Personal communication.

† Formalization of grievance procedures and the institutionalization of adversarial management/labour relations are two of the major consequences of unionization. The union local's grievance committee at Company B, for instance, deals with more than 100 grievances each month. About 20 per cent of these are either conceded or resolved by the company or withdrawn by the grievance committee. The remaining 80 per cent go through a lengthy, and, frequently, acrimonious, process in an attempt to get them resolved. Although the majority are eventually settled, about 18 per cent of all grievances end up before an arbitrator. This process alone justifies the characterization of management/labour relations as one of Resistance since the cost to the local of each one of these grievances is about $3,000.

Compliance. Both the Family and the Adversarial models expect injury rates to be moderate under Accommodation, albeit for different reasons, but Figure 1 seems to indicate that neither models' expectations will be clearly met. The accident rates for Company A (Accommodation) seem to be as high as, or higher than, those for Company C (Compliance).

The Employment/Population Ratio has been included in the model to control for effects of changes in the economic and social environment. Both Companies B and C draw their respective work forces from the same population, and any economic and social indicators should have a similar effect on the workers in each company. What is not known is the degree to which the work force in either company is self-selected for union preference or avoidance. In addition, since I had no data on labour turnover (although it seems to have been low for all three companies), it was not possible to examine an association between labour turnover and accident rates. In any case, analysis of data for Company B indicates a very mature work force.*

The economic dependence of the surrounding region on Company A's plant is probably stronger than that of the surrounding region on Companies B's and C's. This assumption is supported by the Employment/Population Ratio. While that ratio improved somewhat during the year in both regions, with the exception of the month of July, it was always lower in the region around Company A.

A variable (MONTH) has been included to control for the factors that cause changes in injury rates over time but that are not specified in the model. Reported lost-time injuries aggregated for all industries have continued to rise over the years, and inspection of Figure 1 reveals a slight rise over the year in the injury frequency rates for all three companies studied.

The measure of injury frequency used is the natural log of the lost-time injury frequency rate per $10^6$ person-hours worked. The data were log transformed to improve the model's fit.

## Results and Discussion

The empirical results of the model estimation are shown in the ANOVA Table below (Table 4). The large $R^2$ suggests that the model fits the data well. Checks of the residuals for each category of management/labour relations showed no significant autocorrelation.

*Injured workers' mean age was a little over 39 years and seven months, the median, 36. None of the injured was younger than 23 at the time of their accident, while some were as old as 66.

**Table 4** **ANOVA for Lost-Time Accidents (ln) by Management/ Labour Relations, Employment/Population Ratio, and Month**

| Source | Variation | d.f. | MS | F | p |
|---|---|---|---|---|---|
| Condition | 2.472 | 14 | 0.177 | 9.91 | <.0001 |
| Management/ Labour Relations | 1.839 | 2 | 0.920 | 51.60′ | <.0001 |
| Employment/ Population Ratio | 0.008 | 1 | 0.008 | 0.47 | n.s. |
| Month | 0.624 | 11 | 0.057 | 3.18 | <.05 |
| Residuals | 0.374 | 21 | 0.018 | | |
| Total | 2.846 | 35 | | | |

$R^2 = .868$
$s = .133$

The mean lost-time accident frequency rates for the three modes of labour/management relations are shown in Table 5. The large, and statistically significant, F-ratio ($F=9.91$; $df.=14,35$; $p<.0001$) indicates that the injury rate of at least one of the companies is greater than could be expected by way of sampling variation.

**Table 5** **Mean Lost-Time Accident Frequency Rates and Employment/Population Ratio**

| MLR Mode | | Accident Frequency | Employment/ Population Ratio |
|---|---|---|---|
| Accommodation | (Co. A) | 35.824 | 55.93 |
| Resistance | (Co. B) | 21.542 | 58.67 |
| Compliance | (Co. C) | 32.964 | 58.67 |

The management/labour relations effect has a high level of statistical significance ($p<.0001$), demonstrating that different modes of management/labour relations among the three largest companies in Ontario's steel industry are indeed associated with significantly different frequency rates of lost-time accidents. A Duncan Multiple Range Test shows that the mean for the Resistance mode of management/labour relations (Com-

pany B) is significantly lower than that for either the Accommodation (Company A) or Compliance (Company C) modes. This result supports the hypothesis, derived from the Adversarial model, that predicts low accident rates under Resistance.The competing hypothesis, derived from the Family model, is shown to be false.

The lost-time accident frequency rates under Accommodation and Compliance modes are not statistically different from each other. Thus, the Family model hypothesis that predicts lower accident rates under Compliance compared to Accommodation is not supported. There is no support, either, for the Adversarial model hypothesis, which predicts lower accident rates under Accommodation than under Compliance.

While these results appear very strong, they must still be regarded with caution as long as there are no controls for many of the other factors that impinge on accident rates. It is possible – though unlikely – that the age and experience levels of workers in each of the companies are significantly different from each other, for example.

More likely , a factor accounting for some of the difference between accident rates may be the respective companies' productivity per worker. Lacking relevant data, it is difficult to test for this variable. Profitability provides no clue; the most profitable company and the least profitable company (Companies A and C) have statistically indistinguishable accident rates.

Proponents of the Family model might argue that the indicators used in this study are actually picking up reporting differences caused by variation in the degree of management's resistance to workers' complaints, rather than the degree of conflict between management and labour. In other words, they might argue that, under Compliance, management would be least likely to question workers' accident claims. This would mean that the gap between actual accident rates and statistics reported by the company would be small. Under a Resistance mode, however, managers would be most likely to dispute workers' claims, and this would result in a relatively large gap between actual accident rates and statistics reported by the company. Assuming that actual accident rates were the same under both modes of management/labour relations, the statistics would appear to be higher under Compliance due to management's acceptance of workers' claims. To test this assertion, one need only carry the argument a little further to consider predictions under the Accommodation mode of management/labour relations.

If management's resistance to workers' accident claims was the prime cause of variation in accident rate statistics, one would expect Company A's accident rate statistics to be lower than Company C's. Company A's management could be expected to dispute workers' accident claims rather vigorously, given the company's poor economic performance, the relative weakness of labour and the cost to the company of workers' accident compensation premiums. Since there is no statistically discernable difference between Company A's and Company C's reported accident rates, factors other than reporting practices due to management resistance must be implicated. Moreover, while reporting practices may have an impact of official accident statistics, it seems unlikely to be large in the case of lost-time accidents. In the absence of better control variables, we are persuaded to accept the findings that relate lost-time accident rates to management/labour relations, at least, tentatively.

It is interesting to see that January's mean lost-time accident injury frequency rate (20.81) was significantly lower than that of any of the remaining 11 months. This finding is difficult to explain in the absence of a theoretical model that would suggest pertinent predictor variables. While some of the difference might be attributed to the secular trend of rising accident rates, that trend itself is not readily explained.

The Employment/Population Ratio did not approach statistical significance. This finding was somewhat surprising, given the results of earlier studies attesting to the effect of economic variables on morbidity and mortality rates.[23,24,25,26] One explanation may be found in the short time span covered by this study. Over longer periods, the expected impact of economic factors is likely to be more pronounced.

The results of this study refute current political cant and suggest that, among Ontario's major steel producers at least, a compliant and accommodating work force is not the best guarantor of workers' safety.*

## Conclusion

This preliminary report may be criticized on the grounds that it uses rather coarse indicators of management/labour relations. These relations are far more complex

*As the research[2,8] that provided the major theoretical models for this study was carried out in the United States, the United Kingdom and France, as well as on different industries than steel making, it is possible to suggest that management/labour relations in the United States and Canada are articulated by different processes or that these differences have their roots in the distinctive modes of production as they pertain to mining and smelting or automobile manufacture.

than a fairly crude ternary variable, like the one used, can hope to represent. Another criticism might be that this study fails to control more directly for technology, a factor that impinges on management/labour relations. These criticisms should not be ignored; on the contrary, the strength of the results suggests that it would be worth refining an indicator of management/labour relations. This variable seems to be the key to an eventual understanding of social factors that cause work-related accidents and injuries. If nothing else, this study shows that it is simplistic to ask whether unionization has an effect on work-related accidents – a point already indicated by Bennett and Passmore;[27] Weeks;[28] and Grunberg.[29]

Implicitly, these findings warn against a dim-sighted faith in the efficacy of joint health and safety committees as legislated at present.* The mere existence of a committee is no more likely to have a salutary effect on accident rates than is the presence of a union. Finally, the onus is now on the proponents of the Family model to demonstrate that industrial health and safety are best served by 'co-operative solutions' and 'a consensual relationship'.[31]

**Résumé**

Cette étude porte sur l'effet que les relations de travail et la syndicalisation a eu sur le dossier des accidents avec perte de temps en 1985 dans trois grandes aciéries intégrées en Ontario. On propose deux perspectives théoriques incompatibles, le modèle de la famille et le modèle adversatif, et trois modes de relations de travail, chacun étant caractéristique de l'une des trois sociétés. Les différentes hypothèses proposées à partir de chaque perspective de relations de travail sont soumises à une vérification d'après la méthode d'analyse de la variance. Il reste encore du travail à faire, mais les résultats appuient une hypothèse basée sur le modèle adversatif, mais ne confirment pas une hypothèse contraire proposée d'après le modèle de la famille.

* The Ontario *Occupational Health and Safety Act* of 1978 mandates the establishment of joint health and safety committees in most industrial, health and educational workplaces. Broadly speaking, most workplaces employing 20 or more workers have to establish committees of management and labour representatives to advise and to consult with management on occupational health and safety matters. The recent Evaluation of Joint Health and Safety Committees in Ontario by the Advisory Council on Occupational Health and Safety, although not specifically investigating the impact of joint health and safety on accident frequency or severity rates, describes 'the experiment with [committees] . . . as only a partial success'.[30]

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# News and Notes

## A Report on the XXII International Congress on Occupational Health

### Introduction

Two thousand delegates from 51 countries attended the above congress during September 27 – October 2, 1987 in Sydney, Australia. It was the first time in its 80-year history that the congress was held in Australia. Arranged on behalf of the International Commission on Occupational Health by the Australian College of Occupational Medicine, the Australian Institute of Occupational Hygienists, the Australian and New Zealand Society of Occupational Medicine, the Australian Occupational Health Nurses Association, the Ergonomics Society of Australia and New Zealand, and the Safety Institute of Australia, the congress theme 'Work For Health' had two implications. Firstly, work should benefit health, not damage it. Secondly, occupational health practitioners from all over the world should work towards the WHO's goal of 'Health for All by the year 2000'. Major sponsors of the congress were Worksafe Australia and the New South Wales Department of Industrial Relations.

The scientific program was highlighted by eight keynote addresses from invited leading authorities on subjects such as work injuries, occupational neurotoxicology, occupational stress, shift work, behavioural effects of solvents, effects of chemicals on pregnancy and the health effects of new technology. Translation facilities were provided for keynote addresses. 'Meet the Expert' luncheons were a special feature provided to the delegates to meet informally with a keynote speaker and discuss the topic of the keynote address while having lunch. In addition to the keynote addresses, 288 oral presentations and 178 poster presentations selected from 760 abstract submissions were offered concurrently in 36 oral sessions, three symposia, one mini-symposium and 28 poster sessions.

### Monday, September 28, 1987
### Congress Opening

The congress was officially opened at Sydney Opera House by the Honourable Ralph Willis, M.P., Federal Minister for Industrial Relations, Australia. He told the

delegates that after a sad history of neglect, the federal government and most of the state governments had acted to improve the quality and safety of Australian working life. He admitted that the current fatality rate of 77 per million workers each year for a work force of seven million was unacceptably high. The workers' compensation claims in 1984 cost $2.2 billion. It was estimated that more than $6 billion a year were wasted in Australia through loss of production and associated costs because of occupational injury and ill health. At the state level, old-style legislation that focused on negative regulation by external agencies were replaced with more modern legislation that emphasized self-regulation through the recognition of an employer's responsibilities and the involvement of employees in the workplace. At the federal government level, a complementary approach to that of the states, was developed by establishing a tripartite National Occupational Health and Safety Commission, 'Worksafe Australia', to provide a national approach to occupational health research, statistics, standard setting, information services, training, and regulatory controls of industrial chemicals. The objectives at the national level were set to facilitate public debate and discussions, formulate policies and strategies, and to provide a national focus. The national commission has two divisions, a National Occupational and Safety Office and a National Institute of Occupational Health and Safety. The office is responsible for policy development, information dissemination, national standards, the development of strategies and policies and general administration. As the scientific and technical arm of the commission, the institute is responsible for professional training, research, hazard evaluation and the scientific input and testing. The commission had prepared, for public discussion, draft codes of practice on repetitive strain injury, asbestos, treated timber and timber preservatives, and safe manual handling.

Draft codes of practice on lead, noise levels and a range of industrial chemicals are being developed. Significant funds over the past three years had been directed towards the training of workplace representatives, and of front-line managers and supervisors, particularly those in small businesses. Mr. Willis was frank to point out the opposition to health and safety legislative development by the political and business arenas on the alleged grounds of over-regulation and unnecessary cost. Whilst it was concerned to ensure efficient use of taxpayers' money and to avoid undue regulation, the Australian government recognized the absolute essenti-

ality of achieving a much more effective national effort to increase occupational health and safety. He was encouraged by the mix of pure and applied approaches to solving occupational health and safety problems indicated by the wide-ranging variety of papers to be presented at the congress. In closing, he wished the congress every success and declared it open.

## Keynote Address: Work Injuries – Multi-Causal Theory

The first keynote address was delivered by Dr. Dennis Else, Chairman, Health and Safety Unit, Ballarat College of Advanced Education, Ballarat, Victoria, Australia. He analysed the underlying causes in society today for the work injuries of tomorrow:

a) Failure to design in health and safety;
b) Failure to buy in health and safety;
c) Failure to educate the designers and decision makers of tomorrow;
d) Failure to use workplace knowledge;
e) Failure to share successful solutions;
f) Failure to close the knowledge-application gap.

He stressed the need to break out of the cycle of paying inadequate attention to health and safety during the design and purchase of buildings, equipment and processes, followed by taking retrospective palliative action. The delegates were told to create a world in which decision makers and designers should encompass health and safety as another prerequisite.

## Keynote Address: Occupational Health Practice

The invited keynote speaker was Ms. Bernadine Kuchinski, Occupational Health Nurse Consultant/ Educator, NIOSH. She was unable to attend due to illness. The keynote address was delivered by a Swedish delegate on her behalf. It was pointed out that the practice of occupational health, worldwide, is influenced by economic, political and social forces. Industrialized countries attempt to adjust to these forces in the provision of care and in the streamlining of their services. Developing countries struggle to learn from the experiences of others and adapt what is useful. In reviewing the health problems facing workers, she indicated that the price of technological development will bring enormous problems associated with exposure to toxic chemicals. Putting the cost of occupational cancers in the U.S. at $4.4 billion a year, she said the

post-industrial era is now bringing a new set of potential problems to industrial nations: those associated with ceramic fibres, photo-reactive polymers and high purity gases. Many of the super polymers important to aerospace and electronics involve precursors and intermediates that contain carcinogenic substances.

As we move from an industrial-based economy to one of services and information, new hazards are emerging. They are associated with visual outcomes, musculoskeletal outcomes, reproductive outcomes and stress-related outcomes. Workers are not only to be protected from work hazards, but to be informed, participate in decision-making and exercise some element of control. The implied future needs are research, surveillance, health services, and, most importantly, leadership.

## Oral Presentations

Six concurrent sessions for oral presentations were held on the Monday afternoon. In the epidemiology general session, Dr. M. Pekkarinen of The Social Insurance Institute, Finland reported a follow-up study of lumberjacks with vibration-induced white finger. The use of new chain-saws introduced in Finland in 1970 did not cause radiographically detectable bone changes in the hands and wrists of the exposed group. The disease prevalence was 14 per cent in 1978 and 22 per cent in 1985. The disease did not progress during the follow-up. The health effects were associated with exposure durations, but not with age and smoking. No new cases were found for exposures of less than 14 years or 10,000 hours.

In the toxicology-general session, Dr. M. Ikeda, Tohoku University School of Medicine, Japan, reported the mutual metabolic suppression between benzene and toluene in man. The urinary levels of benzene metabolites were lower in the mixed benzene/toluene-exposed group than in the benzene-exposed group, even though the levels of benzene exposures were similar in both groups. Conversely, toluene metabolism was suppressed by co-exposure to benzene, but to a lesser extent. The finding was consistent with animal experiments. It suggested some caution to be used in the interpretation of urinary metabolite levels of workers exposed simultaneously to benzene and toluene and to possible mixed solvent vapours in operations such as gasoline handling.

Mr. C. Winder, Worksafe Australia, discussed the issues of the control and safe use of lead at work. High priority has been given to this within Worksafe Australia because of the need to revise existing state legislation,

which prohibits the employment of women in lead processes. It is discriminatory and contrary to the provisions of the Commonwealth Sex Discrimination Act, 1984. The regulatory approaches being considered in the drafting of Worksafe Australia code of practice for the control and safe use of lead at work include,

- establishing a lower exposure level safe for men, women, infants and the unborn;
- initiating voluntary or mandatory protective re-assignment for women workers at lower exposure levels than those considered acceptable for men workers.

Wide and full discussions to resolve the problems surrounding the scientific, economic and political issues are being held with all concerned parties, including the lowering of the blood lead action level to 25 ug/100 g.

In the same session, A.C. Hawson, National Board of Occupational Safety and Health, Sweden, reported a possible interaction between toluene and noise in causing auditory impairment in rats. O.N. Castellino, Universita' Cattolica, Italy, reported renal effects in rabbits exposed to 1,000-2,000 ppm carbon monoxide for a 1-2 hour period.

## Tuesday, September 29, 1987

Three keynote addresses were delivered in the morning.

## Keynote Address: Solvent Neurotoxicity

The invited keynote speaker was Dr. Edward Baker, Assistant Director, NIOSH, U.S.A. He alerted the delegates that solvent neurotoxicity represents one of the most important emerging issues in occupational health, as the exposure to organic solvents is extremely common in workplaces and can cause problems with the central nervous system. Environmental monitoring is essential for documenting significant exposure and for designing and evaluating worksite control measures. Biological monitoring has its role but must be tailored to the needs of confidentiality and other worksite constraints. Importantly, engineering controls should be used as a primary method to eliminate the potential for organic solvent exposure in the workplace and to prevent fires and explosions. Various closed system designs exist that provide the most effective means for minimizing worker exposure in certain jobs. Whenever possible, workers should be isolated from direct contact with the work environment by the use of automated

equipment. Respiratory protection is also important to consider, although it has limitations. Workers should be educated and trained to understand health risks of exposure, proper use of equipment and other control methods.

## Keynote Address: Occupational Neurotoxicology – Current Problems and Trends

The fourth keynote address was delivered by Professor Fengsheng He, Director of the Institute of Occupational Medicine, Chinese Academy of Preventive Medicine, Beijing, China. Professor He is an internationally well-known neurotoxicologist. Her research on the neurotoxicity of allyl chloride has a high reputation, and her paper entitled 'Chronic Allyl Chloride Poisoning – an Epidemiological, Clinical, Toxicological and Neuropathological Study' was awarded the Scipione Caccuri International Prize from the Fondazione Clinica del Lavoro, Italy in 1984.

She told the delegates that the universe of chemical compounds exceeds five million, of which, about 60,000 chemicals are in current use, with 700-1,000 new chemicals entering commerce each year. Many metals, solvents, pesticides, etc. are neurotoxic to humans at sufficiently high exposure. Their effects on the nervous system range from acute, reversible intoxication to severe pathological damage. The clinical symptoms usually include neurasthenia, polyneuropathy, and toxic encephalopathy.

Over the last decade, precautions have been taken by legislation in most industrialized countries, and the incidence of new severe cases of organic brain disease or peripheral nerve damage due to occupational exposure has declined remarkably. On the other hand, occupational exposure to low levels of neurotoxicants more often causes subtle alternation of central and peripheral nervous function. A selective review of current problems was given with regard to carbon monoxide, solvents, pesticides, heavy metals, acrylamide, carbon disulphide, allyl chloride, dimethylaminopropionitrile, etc.

The trends in investigation are to understand the underlying pathomechanism, improving the neurotoxicity testing and conducting epidemiological investigations. Solutions to the occupational health problems include far more than identification of causal agents and early detection of neurotoxicity. Others are adequate regulations for improvements to working conditions and health status, training of health and safety personnel at differ-

ent levels and mobilizing multisectoral effort by publicizing occupational health and neurotoxicity knowledge.

## Keynote Address: Pregnancy Outcome and Occupation

The above keynote address was delivered by Dr. K. Hemminki, Institute of Occupational Health, Helsinki, Finland. He told the congress that the introduction of new industries and new materials means attention needs to be paid to the impact on employees' reproduction. He referred to the production and fabrication of different plastics, toxins in the textile industry, and new industries such as microelectronics, where toxic and poorly-tested chemicals are used. He suggested the investigation of the reproductive health of hairdressers since they use many chemicals of potential toxicity. Female flight attendants suffer from menstrual disorders, and, as air traffic is ever increasing, large studies on female flight attendants are warranted. He alerted other problem areas such as health workers catching contagious diseases, agricultural areas and even fur farms contaminated by microbial toxins. Physical and psycho-physical factors may play a role in reproductive hazards. He stressed the need for further studies of the effects of night work, heavy lifting, high temperatures, whole body vibration as well as VDT work.

The pitfalls in many reproductive studies on occupational factors usually carried out by interviewing workers were highlighted. Accurate data on reproductive outcomes and exposures are usually difficult to obtain. The latest studies on health care worker exposures to anesthetic gases have not shown significantly increased risks for spontaneous abortions and congenital malformations.

## Oral and Poster Sessions

Six oral sessions and seven poster sessions were held in the afternoon. In the session for topical occupational health, Mrs. E. Brodie, Greater Glasgow Health Board, reported the Legionella experience in the new building of a large general hospital in Glasgow. Fifteen patients and one surgeon were affected, and, eventually, five patients died. The source of the infection was traced to the contamination of a cooling tower from which a plume of spray discharged into the intake vents of the ventilation system. An open policy on reporting the daily progress of the investigation was adopted and helped to allay the anxiety of both staff and the media. Blood samples were taken for serological screening from 100 staff members who felt unwell or worried, and seven

per cent had antibody to Legionella pneumophilia. The experience showed the necessity of bacteriological monitoring of hospital water systems and vigilance in the regular cleansing of water towers and cooling towers. It also showed that good communications, team work and good working relationships were the key factors in controlling and containing the outbreak.

In the occupational allergy session, Dr. W. Kollert, West Germany, reported the incidence of humidifier fever, or Monday fever, a form of hypersensitivity pneumonitis, in a chemical laboratory. Three laboratory technicians were affected, and the disease was confirmed by clinical, haematological, radiological, pulmonological and serological examinations. The technicians worked in two different rooms connected to a common ventilation-humidifier system. The attacks occurred on Monday or on the first day back after a period of absence. Cough, shortness of breath, chest tightness, muscle ache, malaise and fever were the symptoms after an exposure of six to seven hours. The main laboratory findings were distinctly raised sedimentation rate, leucocytosis and precipitating antibodies against aspergillus fumigatus. Symptoms disappeared, and sedimentation rate as well as white blood count returned to normal within eight to 10 days after removal from exposure. Various bacteria and fungi were isolated from the incoming air and the humidifier water. Since renewing the circulating water twice each day and disinfecting the humidifier system with chlorine solution once a week, no relapses have occurred with the system turned on. In the opinion of Dr. Kollert, humidifier fever should be considered a possibility in all cases of recurrent fever accompanied by respiratory disorder.

Four papers related to asbestos were presented in the session for epidemiology-cancer. Dr. B.K. Armstrong, University of Western Australia, reported the mortality of asbestos workers exposed to crocidolite in the mining and milling operations at Wittenoom Gorge, Western Australia. A work population of 6,505 males and 411 females employed between 1943 and 1946 was studied. The median length of employment was 4 months and the median estimated cumulative exposure to crocidolite was 6 fibre/cc.years. In males there were 32 deaths from malignant mesothelioma of the pleura. This disease, as well as neoplasm of the trachea, bronchus and lung, showed increasing mortality with both increasing employment period and increasing cumulative exposure to crocidolite.

Dr. A. Grimwood, Worksafe Australia, reported on the Australian Mesothelioma Surveillance Program and the incidence of mesothelioma in Australia. Among the 839 mesotheliomas notified in the program, 496 cases have been reviewed by the Royal College of Pathologists of Australasia Pathology Panel. The incidence rates are about 18 per million in men and 25 per million in women. The highest rates occurred in Western Australia and the lowest, in Tasmania. About two thirds of the cases were first diagnosed in the age range of 55 to 74. The incidence is higher in Australia than in most other countries where mesothelioma is a problem. Mining of crocidolite at Wittenoom and the widespread use of asbestos in industry contributed to the high incidence rate.

Professor G. Berry, University of Sydney, reported on the mesotheliomas resulting from occupational exposure. Of the 859 mesotheliomas notified to the Australian Mesothelioma Surveillance Program, about two-thirds of the cases were exposed occupationally and five per cent environmentally. About 55 per cent of the cases had exposure periods for 10 years or more, and 75 per cent occurred after more than 30 years following the first occupational exposure. The occupational groups producing the majority of cases were sheet metal workers, carpenters, insulators, electricians, wharf labourers, construction workers, ship and other transport workers, and mechanics.

Another paper was presented by Dr. G.S. Omenn, University of Washington, Seattle, on the trials of chemoprevention of lung cancer with beta-carotene and retinol in asbestos-exposed men. The study is ongoing.

**Wednesday, September 30, 1987**

Eight oral sessions and four poster sessions were held concurrently in the morning. Ms. A. Jorgensen, Sweden, reported in the occupational health nursing session, the occupational health care service given to car mechanics for screening vibration-induced white finger in the early stage. White finger symptoms were found in 42 per cent of the 327 employees by health questionnaire, examination and tests, including cold water provocation. Information and education were given to employees on disease prevention, such as better working methods, tool handling and non-smoking. A vibrometer was used, and early signs of white finger symptoms were seen on the vibrograms. Apparently, Ms. Jorgensen learned of the vibrometer after contacting physicians in a hand surgery

clinic, where the equipment was used on post-operative patients to check the success of hand surgeries.

A paper was presented by Prof. M.L. Huo, Shandong Academy of Medical Science, Peoples Republic of China, on the clinical treatment of pyrethroid poisoning with puerarine. Thirty cases of acute poisoning were caused mainly by oral intake of 20-200 mL of the concentrated pyrethroid formulations. After gastric lavage and venoclysis of fluid, patients were treated by giving peurarine 5 mg/kg iv, and then medication through intravenuous infusion. The daily dosage of peurarine was kept below 20 mg/kg. The treated patients improved prominently after the medication, with GI symptoms, excess salivation and sweating disappearing within two hours. Muscular fibrillation and elevated blood pressure recovered within four to six hours.

In the session for organic dusts, Professor P.L. Lu, Shanghai Medical University, reported on a pulmonary function study in retired cotton textile workers and the relationship to cigarette smoking. The 173 workers studied had worked in the preparatory and spinning departments of a cotton mill in Shanghai for more than 25 years. The control group was made up of 373 healthy, aged-matched individuals with similar social, economic and educational backgrounds but with no history of industrial dust or chemical exposure. There were no significant differences in all lung function parameters between the cotton textile workers and the controls. Cigarette smoking had, however, significant effects on all parameters except FVC. The combined effect of cotton dust exposure and smoking appeared to be additive. It was suggested that the effect of cigarette smoking on the respiratory tract might be mainly located in the small airways.

Several interesting papers were presented in the occupational hygiene session. Professor M. Ikeda, Tohoku University School of Medicine, Japan, reported the use of carbon cloth as diffusive material for passive sampling of organic solvents. The technique is generally applicable to a wide range of solvents, but only with difficulty for ethanol and not recommended at all for methanol sampling. Except for methanol, there was no significant loss for samples wrapped with aluminum foil and stored at 4°C for four days.

Dr. Peter A. Breysse, of the School of Public Health and Community Medicine, University of Washington, reported on formaldehyde exposures, resulting in serious health consequences to office workers. Six case studies were reviewed, and Dr. Breysse stated that formal-

dehyde exposures at concentrations well below 1 ppm can result in serious adverse health effects, both acute and chronic. Furthermore, many office workers are also exposed to formaldehyde at home to concentrations of the same order of magnitude as in their work areas. Consequently, any health standard based on occupational exposure exclusively is unlikely to provide adequate protection.

Dr. Li Lillienberg, Department of Occupational Medicine, Sahlgren Hospital, Sweden, reported occupational exposures in tank cleaning operations. The mean concentration of heating oil vapour in small domestic tanks was below 100 mg/m$^3$ during cleaning periods of 30 minutes. Central heating tanks with light heating oil gave hydrocarbon concentrations of 600-1,500 mg/m$^3$ during one hour of work. The concentration in tanks with heavy heating oil was, in most cases, very low, but the concentration was around 600 mg/m$^3$ when the tank was warm (40-50°C). Big tanks at refinery stations with low boiling naphthas gave hydrocarbon concentrations less than 1,000 mg/m$^3$ when the tanks were ventilated a week or more before tank cleaning. When the ventilation time was very short, concentrations of 2,500 mg/m$^3$ were measured. The corresponding benzene concentration was 70 mg/m$^3$.

Six oral sessions and four poster sessions were held in the afternoon. In addition, three concurrent symposia on industrial disaster planning, hospital occupational health and agricultural health were organized to:

- provide a forum for free discussion of issues within a topic, but structured around short, formally presented papers;
- draw together and record information and ideas emanating from the discussion, leading to the formulation of recommendations.

In each symposium, papers were presented by the chairman, co-chairman and invited speakers. The formal presentations were followed by discussion, with participation and contribution from the delegates. The symposium for industrial disaster planning was opened and chaired by Professor J. Rantanen, Director-General, Institute of Occupational Health, Finland. He talked about occupational health services in chemical emergencies. The co-chairman, Dr. D Griffiths, ICI Australia Operations Pty Ltd., presented a paper on the development of counter emergency plans in industry. Professor T. Fliedner, Federal Republic of Germany, then discussed

the role of industrial medicine in the management of disasters in nuclear establishments. The chairman came back to present the Report of the First World Conference on Chemical Accidents, Rome, July 7-10, 1987. Discussion followed and centred on the following themes:

- Preparedness planning and risk assessment.
- Acute emergency situations.
- Rehabilitation of victims and of contaminated facilities.
- Short and long-term follow up.
- Further development of occupational health services in the management of disasters.

The ideas and information emanated from lead papers and ensuing discussion during the symposium are summarized as follows:

1. Occupational health personnel have the expert knowledge on the effects of chemicals on health to participate in:

   - *prevention* by advising management and technical personnel of potential hazards and safer alternatives in the earliest stages of process development; and, by training workers and managers in charge of control processes;
   - *preparedness planning* by advising of the most likely toxic injuries in the event of an accident, and ensuring adequate planning for first aid, medical services and decontamination facilities, and protection of health and rescue teams and of surrounding neighbourhoods.

2. The following needs were identified in preparedness planning:
   - Audit preparedness plans independently to evaluate their adequacy.
   - Test preparedness plans through simulation.
   - Train, maintain and review training of plant personnel, emergency response teams, community medical services and the general community for the emergency response.

3. The problems recognized in auditing industries included:
   - poor definition of those in charge of emergency response;
   - inadequate training of plant personnel;
   - inadequate liaison with the community;
   - inadequate provision for liaison with media;
   - failure to recognize even major 'holes' in preparedness plans.

4. With regard to the role of occupational health service in the emergency response, the following matters were identified:
   - Vital information about the toxicity of chemicals and their products must be given to emergency response teams without delay.
   - Appropriate first aid and subsequent medical treatment are given to victims.
   - Emergency response teams (e.g. medical, firefighters, police) are adequately protected from contamination and injury.
   - The risk to surrounding neighbourhoods is adequately addressed (e.g. evacuation).
5. Occupational health personnel will often have a primary role in preparedness planning and emergency response in fixed-site accidents, but they do not have operational responsibility in the case of transport accidents. However, they have an important advisory role in the emergency response and are often the only source of essential information regarding toxicity. Their effective collaboration with emergency response teams is critical.
6. Occupational health personnel should be involved in the rehabilitation of the injured worker as well as the accident site. They must be prepared to advise about the safety of re-entry into contaminated areas and the need for protective equipment to be used by the sampling and clean-up teams.
7. It is important to follow up exposed persons to detect chronic effects in individuals and to provide epidemiological data. This may require a choice of a suitable control population and an organization for environmental and biological sampling at the time of the accident.
8. The development of systems for collection of information about industrial disaster occurrences is essential to identify causes and to evaluate the adequacy of preparedness planning and the efficiency of the emergency response.

## Thursday, October 1, 1987

The last three keynote addresses were delivered in the morning of October 1.

## Keynote Address: Health Effects of New Technology

Professor Paule Rey, Occupational Health and Ergonomics Unit, Institute of Social and Preventive Medicine,

University of Geneva, Switzerland, spoke in French on the Health Effects of New Technology. Interpretation in English was provided. She told the congress that a prolonged sitting posture is the major risk in video display terminal (VDT) work. The VDT immobilizes the office employee at the workplace. Prevention of adverse health effects includes:

- applying standards and recommendations at the workplace; an occupational physician can help engineers making choices on furniture;
- training of operators, not only on safety rules but also on the analysis, with the operators themselves, of risks and safe behaviour;
- medical surveillance, including the evaluation of the physical as well as the mental workload with appropriate ergonomic techniques.

**Keynote Address: Stress at Work and Risk of Myocardial Infarction – A Research Program in Sweden**

Professor T. Theorell, National Institute for Psychosocial Factors and Health, Stockholm, reported epidemiological studies that indicated that the conventional 'stress concept' (a lot to do, long working hours, rush, etc.) is not associated with a risk of infarction in a simple way. Work boredom seems to be more dangerous, particularly when combined with 'rush'. The boredom-rush factor may have the same independent predictive power as cigarette smoking. He pointed out many pitfalls in methods for assessing the problems, including the complication that people susceptible to hypertension may under-report problems at work. However, the results consistently showed that adverse psychosocial work conditions are associated with the risk of heart disease. A boring job is associated with elevated risk, particularly if the boredom is combined with excessive demands.

**Keynote Address: The Organization of Work and Shift Work in Developing Countries**

The last keynote address was delivered by Dr. K. Kogi, ILO Regional Advisor on Occupational Safety and Health for Asia and the Pacific, Bangkok, Thailand. He emphasized the need for work organization in coping with technological changes and the impact of new technology. This should promote fuller use of worker skills, group co-operation and participation in planning. The congress was alerted that shift work poses a health

risk for workers, especially when night work is involved. Around 1983, the 12-hour shift system was introduced to many industries in Singapore. It was believed that consecutive 12-hour shifts for 3.5 to four days, followed by three or four days off, would allow more free time to the workers, save time in commuting, contribute to energy conservation and also reduce traffic congestion. It was also believed that extra allowances of the 12-hour shifts would attract workers. The system was short-lived and abolished after less than a year for the following reasons:

- Effects on physical health of the workers, such as tiredness and difficulty in concentrating on work, insufficient sleep, loss of weight and gastric troubles.
- Social factors affecting daily life, including dwelling in units not conducive to sound day-sleep, and clashes with family life routines.
- Significant fall in productivity, and high turnover.

Dr. Kogi reported that poorly organized work, such as repetitive tasks and authoritarian work control, may cause excessive occupational strains with negative effects on the health of workers. Effects are shown in lowered general health status and absenteeism, accidents and ill health. Occupational health services should be organized within the framework of a comprehensive preventive approach and in close co-operation with technology transfer planners, managers and workers.

## Friday, October 2, 1987

Seven oral sessions and seven poster sessions were held in the morning. In addition, two mini-symposia on 'hard-arm vibration' and 'Health Effect of Low Exposure to Mineral Fibres: What is the Evidence?' were organized.

The 'hand-arm vibration' mini-symposium was chaired by Dr. G. Gemne, Institute of Occupational Health, Sweden. The first paper was presented by Dr. J. Starck, Institute of Occupational Health, Finland. He discussed the importance of hand-arm vibration and impulsiveness of noise in the etiology of sensorineural hearing loss (SNHL) for forestry and shipyard workers. Noise and vibration exposures of workers in current and past occupations and in military service were determined. Attenuations of ear protectors and noise levels inside ear protectors were measured with a miniature microphone. The hearing thresholds were measured, and a hearing level at 4kHz was used as a measure of SNHL.

Robinson's model was used for calculating the expected hearing loss. The median noise Leq levels inside the ear muffs were 98 dBA for forestry workers and 86 dBA for shipyard workers when the time periods for wearing ear protectors were taken into account. The frequency-weighted four-hour vibration Leq levels were 2-4 $ms^{-2}$ for both groups. The impulsiveness of vibration and noise were higher in shipyard work than in forestry work. The findings were as follows:

- Military service produced significant hearing damage independent of occupational noise exposure.
- Shipyard workers had more, and forestry workers had less, prominent SNHL than could be predicted from Robinson's model.
- There was no significant additive effect in the SNHL caused by simultaneous exposure to hand-arm vibration.
- Impulsiveness of noise produced a significant increase in SNHL in shipyard workers when compared with non-impulsive noise in forestry workers, even though the noise Leq level was higher in forestry work than in shipyard work!

Dr. Gemne reported a study of finger-blood flow and pressure in 25 chain-saw operators with past histories of vibration-induced Raynaud's Phenomenon. The control group was made up of 14 workers who never had Raynaud's Phenomenon. Measurements were made on one non-anesthetised finger and one finger on the contralateral hand with carbocain anesthesia, after occlusion of the finger-blood flow. The occluded fingers were first warmed with water at 50°C flowing through a cuff and then cooled at 5-10°C. The room temperature was 23-28°C. The chain-sawyers with past VWF history were found to have lower mean values in blood flow and pressure variables in the non-anesthetised finger after warming as well as cooling, and a higher peripheral resistance after cooling than subjects without Raynaud's Phenomenon. Stratification for age, however, eliminated the statistical differences in the blood flow and pressure variables. Dr. Gemne suggested that the disappearance of VWF symptoms in work active chain-sawyers may reflect a reversion to an age-equivalent, normal state of finger circulation.

Dr. U. Hjortsberg, Malmo General Hospital, Sweden, reported the neuropathy and vasospastic reaction in fingers of nine dental technicians exposed to high-frequency vibration from drilling machines (40,000 rpm). The median vibration exposure time was 18 years

(range: three to 42 years). Four dental technicians had white finger. Increased vibration thresholds in fingers exposed to vibration between eight and 500 Hz were found in seven subjects. Dr. Hjortsberg concluded that working with high-speed drills gave injuries of peripheral finger nerves and/or receptors at finger tips. The damage to the vibration tactile receptor system diminished the dental technician's ability to hold work objects and decreased their work performance.

Dr. H. Nakamura, School of Medicine, Kanazawa University, Japan, reported a study on the diagnosis of vibration hazards by a non-invasive monitoring system for peripheral circulation. A new blood flow meter based on the thermal diffusion method using a Pertier stack was developed to continuously observe the regional skin-blood flow of the finger. Peripheral circulatory function of workers who used vibrating tools were studied at rest, and then peripheral circulatory movements during handgrip and local vibration exposure were examined. Next, the changes of the forearm transcutaneous $tcPO_2$ were studied during the cold water immersion test. The vibration-exposed workers were divided into three groups:

- Group A without any symptoms.
- Group B with numbness and/or pain, but without Raynaud's Phenomenon.
- Group C with Raynaud's Phenomenon.

The finger-blood flow of C group was significantly less than that of the A group. In short-term handgrip with a constant strength, the finger-blood flow of A and B groups significantly decreased compared with the reading at rest, but that of C group showed no significant change. In the local exposure to vibration acceleration of 50 $ms^{-2}$ at 60 Hz, the finger-blood flow of A group significantly increased after the start of exposure, but C group did not show an increase.

The forearm $tcPO_2$ in the controls gradually increased during the three minutes after the start of hand immersion in cold water at 5°C, and decreased thereafter. It returned to the initial level in five minutes after the start of immersion. On the other hand, the forearm $tcPO_2$ reading of workers with Raynaud's Phenomenon similarly increased for three minutes after the start of the immersion, but did not change thereafter. Following the end of immersion, the reading slightly decreased, but did not return to the level at the start of the immersion. The lack of change might be induced by the decrease of

cold vasodilation reflex of fingers in vibration-exposed workers with Raynaud's Phenomenon. Dr. Nakamura suggested that the newly developed method and apparatus should be useful to discriminate between workers with and without peripheral circulatory disorders, including those induced by the use of vibrating tools.

Dr. Starck returned to present his second paper in the mini-symposium on the evaluation of individual risk factors affecting noise-induced sensorineural hearing loss among forestry workers and among welders, platers and grinders in shipyard work. This study was a continuation of his first paper presented in the mini-symposium. In their linear regression analysis, aging was the most important single risk factor explaining 15 to 25 per cent of the variation in hearing level. The presence of VWF explained about five per cent of SNHL variation. Smoking only marginally influenced SNHL. Any combination of the individual risk factors increased the risk of SNHL. A combination of VWF, smoking, long exposure time and elevated diastotic blood pressure was most harmful.

A paper by branch staff on an industry-wide air quality survey of bioaerosols in Ontario was presented by the author in the occupational hygiene session. Many delegates were interested in this relatively new topic. Eleven workplaces were surveyed, including two non-bacteriology laboratories, three bacteriology laboratories, an animal research facility, an animal shelter, a hospital dental clinic, a hospital laundry, a chicken slaughter house and a fur-hat manufacturing shop. Three types of air sampling equipment were evaluated, namely the Andersen Two-Stage Microbial Air Sampler, midget impinger and the Biotest RCS Centrifugal Air Sampler. Various air samples were collected for the determination of total bacteria and total fungi generally and, where appropriate, gram-negative rods, total coliforms, etc. All three sampling methods showed similar and comparable results within the same order of magnitude at workplaces with general or low-level contamination sources. The Biotest Sampler appeared to reflect most distinctly the relative changes in levels associated with work tasks and work practices. It offers the advantage of short-term air sampling at the worker's breathing zone, particularly in workplaces where space is rather limited. Impinger sampling appeared to be a promising technique. There are greater needs, however, for precaution and judgement in determining the appropriate sampling durations at contaminated workplaces and in taking the appropriate sample solution aliquots for inoculation and incubation. The highest total bacterial levels were found

in the chicken slaughter house, hospital laundry and one of the hospital bacteriology laboratories. The highest total fungal levels were found in the chicken slaughter house, the hospital laundry and the food bacteriology laboratory, but they were relatively lower than the total bacterial levels. Human activities and movement could contribute to bioaerosol levels. Many delegates were interested in the health significance of the bioaerosol levels; they were advised of the health effects study being planned in Phase 2 of the study.

*D. K. N. Leong*

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**The 11th and 12th Semi-Annual Intensive Workshops in Industrial Hygiene. University of Toronto.**

**Monday, April 25, 1988 to Friday, April 29, 1988 and Monday, September 26, 1988 to Friday, September 30, 1988.**

These workshops are designed for those who, for the following reasons, would benefit by taking the course:

- to increase knowledge of their specialization in occupational hygiene;
- feel the need for a general refresher course;
- for recent entrants to the hygiene field who wish to broaden their background knowledge of occupational hygiene.

The panel of lecturers includes Dr. John Steel, Dip,Occ.Hyg., from the Department of Occupational Health and Hygiene, Medical School, University of Newcastle-upon-Tyne, United Kingdom, personnel from the Ontario Ministry of Labour, and faculty and staff of the University of Toronto. The expertise of the speakers covers all relevant aspects of hygiene, risk assessment, human factors engineering, toxicology, occupational medicine, and occupational health and safety legislation. A hands-on equipment demonstration and monitoring round-table are included in the workshop.

The Industrial Hygiene and Hazard Control Engineering Program of the University of Toronto presents the workshops bi-annually. Professor J. W. Smith, Ph.D., C.Eng., C.I.H., chairman of the Department of Chemical Engineering and Applied Chemistry is the program co-ordinator.

Enquiries should be addressed to:

Secretary of Occupational Health and Safety,
Department of Chemical Engineering
and Applied Chemistry,
University of Toronto,
Toronto, Ontario
M5S 1A4.
(416) 978-3066.

# Coming Events

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| April 12-15, 1988 | Annual British Occupational Hygiene Society Conference. NOTTINGHAM, ENGLAND.<br>For further information, contact:<br>BOHS, 1 St. Andrew's Place, Regent's Park, London, England, NW1 4LB. |
| April 19-20, 1988 | Particle Size Analysis 1988, GUILDFORD, U.K.<br>For further information, contact:<br>PSA '88, Dept. of Chemical & Process Engineering, University of Surrey, Guildford, Surrey, England, GU2 5XH. Phone 0483 509170 |
| April 27-29, 1988 | 4th Symposium on Handling of Environmental and Biological Samples in Chromatography, BASLE, SWITZERLAND.<br>For further information, contact:<br>Professor R. W. Frei, Department of Analytical Chemistry, Free University, De Boelelaan 1083, 1081 HV Amsterdam, The Netherlands. Phone (020) 5485379. |
| May 4-6, 1988 | Back Pain – Current Concepts and Recent Advances – 2nd European Conference. MONTREAUX, SWITZERLAND.<br>For further information, contact:<br>Secretariat, Congress Team International (U.K.) Ltd., 30 Deane Way, Ruislip, Middlesex, England, HA4 85X. |
| May 4-8, 1988 | World Congress II on Asbestos Abatement, LAS VEGAS, U.S.A.<br>For further information, contact:<br>Asbestos Abatement, World Congress of the Association of the Wall & Ceiling Industries, 25 K Street, N.E., Suite 300, Washington, D.C., 20002. |
| May 10-12, 1988 | HAZTECH Canada Conference and Exhibition – 1988 Dangerous Goods and Hazardous Waste Conference, MISSISSAUGA, CANADA.<br>For further information, contact:<br>Chuck Bierley, Exhibition Management Co., Inc., 6143 S. Willow Drive, Suite 100, Englewood, CO, U.S.A., 80111; Phone (303) 850-9119. |

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| May 15-20, 1988 | 1988 American Industrial Hygiene Conference. 'Joint Activities in Industrial Hygiene', SAN FRANCISCO, CALIFORNIA, U.S.A.<br>For further information, contact:<br>Patricia George, AIHC, 475 Wolf Ledges Parkway, Akron, OH, U.S.A. 44311-1087. |
| June 6-8, 1988 | International Social Security Association's International Section for the Chemical Industry – Current Issues in Biotechnology Genetic Engineering and in Substances Hazardous to Health, FRANKFURT, FRG.<br>For further information, contact:<br>Sekretariat der Internationalen Sektion der IVSS, Postfach 10 14 80, D-6900 Heidelberg 1, FRG, 0 62 21 52 30. |
| June 6-9, 1988 | First Congress of the International Society of Ocular Toxicology, TORONTO, CANADA.<br>For further information, contact:<br>Sandra Leith, Continuing Medical Education, University of Toronto, Toronto, Ont., Canada, M5S 1A8.<br>Phone (416) 978-2718. |
| June 14-16, 1988 | 3rd IFAC/IFIP/IEA/IFORS Conference on Man-Machine Systems Analysis, Design and Evaluation, OULU, FINLAND.<br>For further information, contact:<br>3rd MMS, The Finnish Society of Automatic, PO Box 165, Helsinki, Finland, SF-00101. |
| June 20-22, 1988 | 1988 National Conference on Noise Control Engineering, WEST LAFAYETTE, INDIANA, U.S.A.<br>For further information, contact:<br>Conference Secretary. R. W. Herrick Laboratories, School of Mechanical Engineering, Purdue, U.S.A. |
| June 25-30, 1988 | National Environmental Health Association 52nd Annual Educational Conference, CLEVELAND, U.S.A.<br>For further information, contact:<br>M. Monkelis, Conference Program Co-ordinator, 720 S. Colorado Blvd., Room 970, South Tower, Denver, Colorado, 80222. |
| July 11-15, 1988 | Society of Occupational Medicine, Annual Provincial Meeting: New Technology — New Challenges. GUILDFORD, ENGLAND.<br>For further information, contact:<br>Dr. I. M. Dawson, Society of Occupational Medicine, London Group, 6 St. Andrew's Place, Regent's Park, London, England, NW1 4LB. |

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| August 1-5, 1988 | International Ergonomics Association 10th Congress, SYDNEY, AUSTRALIA.<br>For further information, contact:<br>Secretariat IEA88, PO Box 380, Spit Junction, NSW, Australia, 2088. |
| August 12-16, 1988 | First Symposium on Biological Effects, Hazards and Protection from NonIonizing Radiation in Outdoor Applications. STOCKHOLM, SWEDEN.<br>For further information, contact:<br>NIRO 87, c/o KREAB Congrex, Box 5619, Stockholm, Sweden, S-114 86. |
| August 15-18, 1988 | ICCEF 88. Third International Conference on the Combined Effects of Environmental Factors, FINLAND.<br>For further information, contact:<br>Chairman, Doc DR Olavi Manninen, ICCEF 88, Secretariat, c/o Dept. of Public Health, Medical Faculty, University of Tampere, P.O. Box 607, Tampere, Finland, SF-33101. |
| August 16-18, 1988 | Sixth International Symposium on Epidemiology in Occupational Health, STOCKHOLM, SWEDEN.<br>For further information, contact:<br>Sixth International Symposium on Epidemiology in Occupational Health, c/o Stockholm Convention Bureau, Box 6911, Stockholm, Sweden, S-102 39. |
| August 21-25, 1988 | Noise '88 – The 5th International Congress on Noise as a Public Health Problem – STOCKHOLM, SWEDEN.<br>For further information, contact:<br>Noise '88, c/o Reso Congress Service, Stockholm, Sweden, S-113 92. |
| August 23-26, 1988 | VIIth International Pneumoconioses Conference, PITTSBURGH, U.S.A.<br>For further information, contact:<br>Robert E. Glenn, Conference Chairman, National Institute for Occupational Safety and Health, 944 Chestnut Ridge Road, Morgantown, West Virginia, U.S.A., 26505-2888. |
| August 30-<br>September 1, 1988 | Inter-Noise 88. 17th International Conference on Noise Control Engineering, AVIGNON, FRANCE.<br>For further information, contact:<br>Inter-Noise 88, Secretariat, BP 23, Senlis Cedex, France, F 60302. |

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| September 5-8, 1988 | CIB Conference – Healthy Buildings '88.<br>STOCKHOLM, SWEDEN.<br>For further information, contact:<br>The Swedish Council for Research, S:t Goransgatan 66, Stockholm, Sweden, S-112 33. |
| September 5-9, 1988 | Fourth International Conference on Nickel Metabolism and Toxicology. ESPOO, FINLAND.<br>For further information, contact:<br>Fourth International Conference on Nickel Metabolism and Toxicology, c/o Institute of Occupational Health/Ms Seija Toro, Topeliuksenkatu 41 a A, Helsinki, Finland, SF-00250. Phone: (+358 0) 474 71, Telex: 121394 tltx sf occuphealth, Telefax: 414634. |
| September 20-23, 1988 | Second International Symposium on Ventilation for Contaminant Control, Ventilation 88,<br>LONDON, ENGLAND.<br>For further information, contact:<br>British Occupational Hygiene Society, 1 St. Andrew's Place, Regent's Park, London, England, NW1 4LB. |
| October 5-8, 1988 | ICOH Scientific Committee – Second International Workshop on Personal Computer and Data Banks in Occupational Health, PALMA DE MALLORCA, SPAIN.<br>For further information, contact:<br>Dr. Jose Sevillaa, Mutua Balear, c/. Obispo Campins 4, Palma de Mallorca, Balear Islands, Spain. |

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